AUTOMOBILE SEAT BELTS

UNIVERSITY OF MICHIGAN

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HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE HOUSE OF REPRESENTATIVES

EIGHTY-FIFTH CONGRESS

FIRST SESSION

ON

CRASHWORTHINESS OF AUTOMOBILE SEAT BELTS

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AUTOMOBILE SEAT BELTS

TUESDAY, APRIL 30, 1957

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON TRAFFIC SAFETY
OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The special subcommittee met at 10 a. m., pursuant to call, in room 1301, New House Office Building, Hon. Samuel N. Friedel, presiding.

Mr. FRIEDEL. The Special Subcommittee on Traffic Safety will come to order.

We are very pleased to hold this hearing this morning and have the opportunity to hear from John O. Moore, director of automotive crash injury research, Cornell University Medical College. Mr. Moore has previously testified before this subcommittee, and last year guided the subcommittee through the crash injury research organization in New York.

We are also pleased to have as a witness Edward R. Dye, director of safety design and development, Cornell Aeronautical Laboratory.

The subcommittee has received some comments questioning the real value of using safety belts in automobiles. It is our understanding that the Cornell automotive crash injury research has made a scientific study of the usefulness of safety belts in crashes.

We greatly appreciate Mr. Moore and Mr. Dye appearing this morning to inform the subcommittee of their research findings so that all of us may work to advance safety in behalf of the public.

I should like to state that Chairman Roberts is extremely sorry that he is unable to be here this morning due to a prior engagement which could not be canceled. We are also sorry that Congressman Beamer is unable to be here this morning due to illness, and Congressman Loser is out of town. So this is going to be a one-man committee, and it will be unbiased, I can assure you of that.

Dr. Moore, will you please step forward?

We also have with us Mr. Henry Barnes, the Baltimore City traffic safety engineer, and he has volunteered his services free of charge to the committee in an advisory capacity on safety of automobiles on highways and in cities.

Mr. Moore?

STATEMENT OF JOHN O. MOORE, DIRECTOR OF AUTOMOTIVE CRASH INJURY RESEARCH, CORNELL UNIVERSITY MEDICAL COLLEGE

Mr. MOORE. Congressman, it is a great privilege you have extended to us to make available to the committee the results of the work we are doing in evaluating the need for and the results produced by safety belts when they are used.

We are very anxious to make available our knowledge at this time because of the wave of confusion that is abroad as evidenced by articles appearing in many of our recent publications.

Mr. FRIEDEL. Would you mind putting that speaker in the center?

Mr. MOORE. In recent months there have been articles appearing in leading publications questioning seriously the use of a restraining device as a means of controlling injury in automobile accidents.

A great deal of the material which has been quoted raises some question in our mind as to the accuracy of the population being sampled in the tests that are reported to demonstrate that the safety belt is not an effective device and, furthermore, it is actually dangerous.

If I may, with your permission, summarize something of the history of this concept:

We believe there are two ways in which injury may be controlled in automobile accidents. The first method of controlling injury that we know about is to so engineer the structure ahead of the unrestrained passenger that in the event of sudden deceleration he can hit only objects which can be bent before biological tissue is injured, and the work of slowing down the body is absorbed by the work of bending the structure.

In cases where it is not possible to engineer a package so soft and so bendable ahead of the occupant that it will not hurt him, it then becomes possible only to prevent him from reaching this lethal arrangement of structure by some method of restraint.

Our work at Cornell is part of a committee. This committee is known as the Cornell University Committee on Transportation Safety Research, and the committee is represented in the medical or epidemiological field by our program at the Medical College. It is represented in the engineering field by the design and development group under Mr. Dye at Cornell Aeronautical Laboratory. And then it has available for consultation the sciences of sociology and psychology at the university, as well as the university engineering department.

So our statements this morning are being made from the standpoint of the Cornell Committee on Transportation Safety Research.

Now I will attempt to comment on the information we have obtained from the interstate automotive crash injury program, in which we have humans in automobiles in accidents in which belts were used, and are able to compare these humans with humans in automobiles in similar accidents in which no belts were used.

I should like for Mr. Dye to have the responsibility to discuss the engineering justification behind the concept of restraining passengers.

We have found that the human body has a very great tolerance for stress across the pelvic area. It is therefore desirable that, if restraint is to be used, it should be placed at such a point as near the center of gravity of the body as possible, and across the strongest possible section of the body frame. The hips present the ideal position for attaching a method of restraint.

It might be wise to add that, in the past, the group at Cornell Medical College has evaluated safety belts in light-aircraft accidents. We have published a study on this, examining some thousand-odd people who were in aviation accidents and who wore belts.

We found that the human body is quite capable of breaking a 3,000-pound test belt without evidence of injury to abdominal viscera. There

is some evidence that this force of breaking a 3,000-pound loop-strength belt will produce bruising of the hips; but this, according to our classification, is considered an injury of very minor nature.

So we have not been able, in some 10 years of studying the problem of restraint, to associate the belt with the ability to produce injury in and of itself.

In the current study that is being conducted, our sponsorship arises for this research work from the Defense Department's Armed Forces Epidemiological Board and the United States Public Health Service, and unencumbered research grants have been received from Ford Motor Co. and Chrysler Motor Corp.

With the research staff made possible by these grants, we have developed in our present program, an interstate cooperative effort between the State police, the State medical society, the State department of public health, and the State hospital associations, a fact-finding investigation using sampling methods for studying injury-producing as well as property damage automobile accidents.

The material used in this testimony has been gathered from sample areas on the highways of the States of North Carolina, Virginia, Maryland, Connecticut, Indiana, Pennsylvania, Vermont, Minnesota, Arizona, Texas, California, and we feel that we are able to present it as a representative sample of the accident population on a fairly acceptable national level.

Many of our findings at this stage must be declared to be preliminary, but we feel that they are scientifically accurate, and that the preliminary findings will be borne out as the data collection system exists for a long enough time to build up a still larger volume of data.

In evaluating restraining devices as a means of preventing the occupant from reaching structure ahead of him that cannot be bent as easily as his biological tissue can be damaged, we have adopted a technique of paired comparisons.

In this technique, we take an accident in which no belt is used, we select an accident in which a belt is used, and then we judge the suitability of using this data if these two cases are alike as to 10 points of similarity:

The cars must be alike as to make; they must be alike as to year of manufacture; there must be the same number of automobiles involved in the accident; the seated areas of the occupants must be similar and exposure to open doors must be the same; the type of accident must be similar; the area of the principal impacts must be similar; and the direction from which the force is applied to that area of impact must be similar; and the speed at the time of the impact, as best we are able to determine it from our reported data, must be within 5 miles an hour of each other. We have been successful in matching 81 accidents where ejection was not a factor, and 46 cases where, under matched conditions, safety-belt users remained in the car while nonusers were ejected.

We have received over 400 safety belt case histories, and we have approximately 10,000 injury-producing accidents, so that the matching indicates we have been able to do considerable research in trying to pick out identical situations, and to do this must have a massive volume of data.

These arrange themselves throughout the range of severity. But wherever they fall in the range of severity, severity being measured

in our work by the amount of deformation of the automobile structure, wherever they fall in the range of severity they are offset on the opposite side with an identical situation within the same range of severity.

Where the case has a belt in a minor accident, it is matched with a similar minor accident without a belt; and where the belt was involved in a severe accident, it is matched by a case without a belt in a similar accident.

We have examined the frequency of injury in the nonejection cases in which no belt was used, and found that 75.5 percent of the people in these cars had an injury to some degree, the injury being reported to us by the physician who treated the patient. We have found that 23 percent of the people in the cars without belts had an injury that fell in the moderate, severe, critical, dangerous, or fatal range. We have found that 3.6 percent of the people in these cars without belts had an injury that must be classified as dangerous to life or fatal within 24 hours.

When we examined the frequency of injuries in the matching cases of cars using a restraining device, a seat belt, we found that 29.9 percent of the people had an injury to some degree. Only 9.2 percent of the people had an injury that was classified as moderate, severe, critical, dangerous, or fatal. And only 1 percent of the people had an injury that was classified as dangerous or fatal.

We have determined that the differences in frequency of the first two grades of injury are significant at the 98.0 percent level of confidence, which is a means of examining the validity of a distribution of this material.

We have found that the ratio of difference between the frequency of injury in the nonejected control group or the no-belt group as compared with the nonejected experimental or belted group, is such that the belt gives us a maximum improvement at the present time of approxmiately 60 percent with respect to the risk of injury.

We would like to state that we have evidence that people who do wear belts on occasion are killed. We do not represent that the restraining device should ever be considered to be a panacea or a cure-all.

But we do feel that it is a device which is within the price range of most automobile owners, and it is a device which can be installed on any automobile, whether it be a new or old automobile, and it can be installed at the present time.

On the basis of our preliminary examination, the material I have just spoken about compares only people who stayed in the automobile; and it, I think, answers the argument that the pivoting of the human body around the belt is going to produce a dangerous result, far more dangerous than if you have no belt, because among the occupants in both matching groups of 81 cars, none were ejected.

Even so, the people who had the belt and did pivot over it and hit things with their heads, still had 60 percent less injury than the people who went forward without the belt and hit their head.

Mr. Dye can comment upon the engineering principle behind this observed result better than I.

We have done an additional preliminary study in which we have been able to match 41—I beg your pardon—36 cars into 2 paired com-

parisons. There were 46 front-seat occupants in each of these 2 groups of cars. These pairs have been matched in these ways: The type of accident was similar; the area of principal impact was similar; the direction of the force in this area of impact was similar; the speeds were within 5 miles an hour of each other; they had the same number of door openings, and the same number of cars per accident were involved; the same make of car was paired; the same weight of car was paired; the same year of manufacture of the vehicle was paired; and the paired occupants occupied the same seat; the accident's severity was similar; and the body styles alike.

When we took the 46 occupants of the 36 cars who were ejected from the vehicle, and determined the frequency of their injury, we found that 87 percent of these people had an injury to some degree. We found that 53.7 percent of these ejected persons had an injury in the moderate, severe, serious, critical, dangerous, or fatal range. We found that 17.4 percent of these people were either killed or sustained injuries so severe that their condition was still critical after 24 hours.

We then studied the 46 matched people, none of whom were ejected, because they were wearing a restraining device or safety belt, and we found that 39.3 percent of these belted people had an injury to some degree.

We found that 10.9 percent of these people had an injury in the moderate, critical, fatal range. We found that 2.2 percent of these people had an injury in the dangerous or fatal range.

This represents, at the 95 or higher percent level of confidence, a 54.8 percent reduction in the appearance of any grade of injury. It represents a 79.7 percent reduction in the appearance of moderate, serious, critical, severe, or fatal injuries. It represents an 87 percent reduction in the frequency of dangerous and fatal injuries.

This study, while it is of a preliminary nature, has been done with the greatest of care in an effort to estimate the value of a device for controlling injury when the accident occurs.

Mr. FRIEDEL. What was the period of your investigation, for a year, 6 months, or 3 months?

Mr. MOORE. These data, sir, have been collected over a period of 2 years.

Mr. FRIEDEL. Two years.

Mr. MOORE. The data on the control group, or the injury-producing accidents without belt, or property damage, have been collected from the period starting September 1953, through the current month. The data on safety belts have been collected in the last 2 years.

It might be interesting to make a statement on how the data are obtained. We have designed a standard factfinding form. The program when undertaken by a State is an official endeavor by the State department of police or State highway patrol. It is also an official endeavor on the part of the State medical society.

The data regarding the damage to the vehicle and all the details of this vehicle, along with photographs of the vehicle, are prepared by the State police after their troopers have been trained by our field personnel.

The data on injuries are obtained from the physician who treats the patient, and are processed from his hands to the local health director, in turn to the State department of public health, and in turn to Cor-

nell Medical College, where the data are then analyzed by teams of analysts.

Each case is evaluated by two analysts independent of each other in order to eliminate as much as possible subjective evaluation of factors.

I feel, in view of the controversy carried in some recent publications, that the committee would be anxious to find out how we have gone about our studies and how we have arrived at the conclusion.

I feel it necessary to comment that many of the tests which have been performed by groups expressing doubt regarding the usefulness of the belt have been car crashes using dummies against immovable-type barricades.

The data we have on injury-producing accidents from our national sample indicate that in only 16 percent of the accidents which produce injury to occupants does the car hit an immovable object.

Eighty-four percent of the time in rural accidents, and 81 percent of the time in urban accidents, the car is not hitting an immovable object. It is obvious that, when the car strikes an immovable barricade or pole or tree, the deceleration pattern is a very severe and extreme one. To condemn a device that fails to work under these conditions is somewhat like remarking that 16 percent of the people in the country are allergic to penicillin, and, therefore, we cannot make any penicillin to treat the 84 percent of the people who are not allergic and can be cured by it.

I do not mean to liken the safety belt to the ability of penicillin to cure disease, but, in truth, trauma in highway accidents is a national disease, and there is a method of therapy which offers some hope as far as our data lets us go at this time.

Now, I would like for Mr. Dye to give you some of the data about the engineering developments that went behind the position which the Cornell committee on transportation safety research took in recommending belts to the public and establishing a criteria for those belts to meet, over 2 years ago. So, if I may, I would like to ask Mr. Dye to continue the testimony.

Mr. FRIEDEL. Before that, doctor, I want to say I remember sometime last year when our committee visited with you in New York, and you were very fair about it, because at that time you then did not know whether the safety belt was safe or not.

Then, when we saw you in Detroit, you said that after further studies you were convinced that it was reducing injuries from accidents, and for that reason I want to tell you that I have safety belts on my car.

Mr. MOORE. Good, sir. I find that I am very grateful for the opportunity to be able to buy a belt that is properly engineered and properly installed at the factory, instead of having to let me cobble up my own installation. And I have 7 children, so that I have 9 belts in my station wagon.

Mr. FRIEDEL. All right. We will now hear from Mr. Edward R. Dye, director, safety design and development, Cornell Aeronautical Laboratory.

STATEMENT OF EDWARD R. DYE, HEAD, SAFETY DESIGN RESEARCH DEPARTMENT, CORNELL AERONAUTICAL LABORATORY, CORNELL UNIVERSITY

Mr. DYE. Congressman, I am, as you say, the head of the safety design research department of Cornell Aeronautical Laboratory, and a member of the transportation safety research committee of Cornell University.

Since 1947, we have been conducting research in applied engineering and physics of the performance of a human being during the crash-deceleration period. Some of this has been in aircraft-crash work, and a good deal of it has been in the automobile-crash problem.

In 1947, a problem arose about the lap belt as used in aircraft work. There was some question at that time as to whether the head would swing forward when the body was restrained by the lap belt, and hit with a harder force than it would without the belt.

This was such a question that could best be answered by what we call a simulator. This is a device which could simulate the crash and measure the forces.

We constructed a suitably articulated dummy, made of sheet metal, and which operated in a coplanar cockpit. This sheet-metal dummy was full scale in dimension, and properly weighted to simulate the relative parts of the human body. He was accelerated in a cockpit on the floor of our laboratory, and retained with a lap belt, in a manner that we could adjust the lap belt from a vertical lap belt to a 30° to a 60°, to a horizontal direction, and also we could adjust the slack of the lap belt so that it could be ranged from a half inch of hip movement to as much as 4 inches of hip movement. We wanted to determine the effect of the angle of the belt, and the effect of the slack of the belt.

Now, as part of the instrumentation, each joint of this dummy had an insulated, that is, an electrically insulated, pencil lead writing on a paper background in the cockpit. Each joint then scribed for us the path of the joint.

Also, we determined the time interval by feeding to these insulated pencil leads an electrical spark at the rate of 90 per second. This gave us, then, the basic information to determine the velocity of striking of any of the component parts of the body, and, also, we could take this information and determine the acceleration and deceleration.

Also, since we were interested primarily in impact blows to the head, we devised an energy-absorbing gage which worked on a penetration principle; taking so many inch pounds of work, to penetrate, say, 1 inch, it would take twice that amount of energy to penetrate 2 inches, and so forth.

This energy-absorbing gage was used to measure the energy of the blow to the head under these various seat-belt conditions. I won't bore you by repeating the details of that entire program, but I have a record of it here which I can leave with the committee, if they wish.

Basically, we found that the seat belt, although it did allow the head to strike an object, say, 27 inches forward of the head, the head blow under identical decelerating conditions was in the order of

one-third to one-fourth that of the energy of the blow without the seat belt.

Many other projects since that time, some 27 in all, were supported by various organizations. United States Rubber supported a project to develop a padding material to protect the head. We learned considerable about the blows to the head by and through a project supported by the Office of Naval Research Medical Science Division.

Later, starting in 1952, Liberty Mutual Insurance Co. sponsored a project at our laboratory to determine how people move in a decelerating car or a crashing car, and what attitude were they in when they struck, how hard did they strike, and what was the probability of hitting any one object.

In this project we removed the door of a conventional 2-door sedan and replaced it with a grid screen. We used two dummies, articulated dummies, referred to as anthropometric dummies. These were, we believe, the first ones ever built, one representing a full-grown, 180-pound man, and the other a 6-year-old child.

These dummies, again, were full dimensioned and proportionately weighted so that their movements of inertia and, therefore, their kinematic motion would be similar to that of the human body during the crash period. The joints were arranged so that we could tighten them to represent muscular restraint such as bracing of the feet and arms in various positions.

This car was arranged to run down a track under its own power, and we had a snubbing device which could decelerate the car at various controlled rates, so that we could study what happened to the human inside the car during the crash period. Photographs were taken with high-speed movie cameras; deceleration was again measured by accurate time clocks and decelerometers, and from this we obtained a great deal of information on how people moved within the car body during the crash period.

I might say, if you have not seen the movies of these crash-snubbing pictures, I would be very happy to send them to the committee. The record is on a 16-millimeter sound movie, explaining the entire experiment.

Mr. FRIEDEL. The committee has already seen the movies, and also has seen the actual performance at the proving grounds of the various manufacturers.

Mr. DYE. Good. I see. We learned from this that all motions, even though the impact velocity was quite low, were quite violent. The youngster would be thrown violently from the back seat to the front, and very often, after hitting his head and other parts of his body several times, would be thrown back into the back seat, making a round trip in something less than three-quarters of a second.

The trip forward from the front seat to the windshield, the windshield header and instrument panel, at impact velocities of around 15 to 17 miles an hour would be in the order of a quarter of a second.

So that high-speed movie technique we believe is the only way to accurately study these motions, frame by frame.

From this we learned that the human body is thrown against the "anvil" in the front of the cockpit at various attitudes. For instance, the child is very often thrown from the back seat to the windshield in a swan dive attitude where the entire weight of the body is behind the head blow, where in the front seat the child would

slide off the seat and his head would hit with a blow at almost right angles to the longitudinal axis of the body.

With the same velocity of impact and the same rate of stopping, these two head blow conditions are entirely different. For example, the impact blow to the head of the child sliding from the front seat is about 8 percent of the kinetic energy of his entire body; whereas in the dive-over attitude from the back seat, it sometimes reaches as high as 78 percent of the kinetic energy of the entire body.

So we refer to this as the attitude effect. That is, if the person is diving or if he is moving in such a manner that a great deal of the mass of the body is behind the head at the instant of striking, it creates an entirely different picture.

Also, the angle of the object struck: If the head strikes a glancing blow, the impact blow, of course, is only a component of the force. If the blow is at right angles to the flight path, then the blow will, of course, be much greater.

There were many other studies that are connected with the problem. They include injury-producing effects of various objects on the instrument panel, such as the mounting of tubes and knobs, the rigidity of the instrument panel, and so forth.

We took the information from this field study. Here, I refer to the field study as our laboratory out in back of the laboratory on our deceleration track, and we simulated these attitudes by dropping our "thin man" from various attitudes onto the energy absorbing gage. We found that this gave us a measure of the ratio of impact blows to the head, to the entire kinetic energy of the body.

Now, you wonder, what does this have to do with seat belts? Well, it helps us explain why the seat belt is such an effective device, even though the head does strike. Early we found that in the "thin man" work, we were reducing the head blows from one-third to one-fourth of the head blow. This helped us to accurately explain by scientific methods why this did occur.

We were actually controlling the attitude of the blow. So that the seat belt not only restrains the greater mass of the body, but it also controls the motion of the upper part of the body so that the blow is always at about right angles to the longitudinal axis of the torso. This gets it down into the category of the 8 percent of the kinetic energy of the body I previously mentioned.

We have made studies of shoulder harness. In fact, I have some pictures here of installations of shoulder harness, and their testing.

The shoulder harness, of course, is a much more effective device, because it holds the torso, shoulders, and pelvis in position. There was a question at one time brought before the Cornell Committee on Transportation Safety Research: Should we suggest to the public that they use shoulder harness, or should we recommend the lap harness?

We found by a study that more people, by far more people, would wear a lap harness than would wear a shoulder harness. Most women will not wear shoulder harness because of a feeling of claustrophobia, it doesn't fit, and also it has a tendency to wrinkle up the blouse or beautiful dress.

Mr. FRIEDEL. Is it not true they would have to have higher seats, which would obstruct your view in the rear-view mirror?

Mr. DYE. You are correct. The actual attachment to the car——

Mr. FRIEDEL. Rear window, rather.

Mr. DYE (continuing). Is a much more difficult procedure for the shoulder harness than for the lap harness. So by taking the protective value of the lap harness and multiplying by the number of people we thought we could get to wear the lap harness, we came up with a measure of safety improvement. This is a measure of the improvement we thought we could make. The number we could get to wear the shoulder harness is quite small, and even though the protection is high, the amount of good would be quite small.

So that the Cornell Committee on Transportation Safety recommended the lap harness, properly installed and properly used, as a very effective way of reducing injury and death.

I personally have 2 cars, 6 belts in each car, and have used them for about 10 years now. On the question of getting a child to wear a seat belt, I find it is a matter of training. If you start them out with a belt——

Mr. FRIEDEL. I wish you would elaborate a little bit more on properly installing them, for the record.

Mr. DYE. Yes. We recommend that the lap belt be installed so that the belt is approximately in a longitudinal vertical plane of the car, and also that the belt is at an angle approximately 45° from the horizontal.

Vertical belts, belts that are in a transverse vertical plane, are of no practical value. They don't give the horizontal component necessary to hold a person back in his seat.

In like manner, the horizontal belt is not effective because it does not give vertical component necessary to stabilize the person. So that our recommendations have been between 30° and 60° from the horizontal as an effective angle for the belt.

Also, the installation should be either to the frame or to the floor, but properly stressed so that the attachment is equal to the strength of the belt. We have been recommending that the belt have a loop strength, through the complete attachment, of 3,000 pounds, and that the buckle be of such a construction that after it has received this 3,000-pound loop belt load, that it can be released with 1 hand, with a pull of less than 45 pounds. This is to take care of the person who finds his car upside down when he wants to get out. We expect him to use one hand and protect himself from the fall with the other hand.

Many of these specifications have come down through the Civil Aeronautics Administration and the aircraft industry.

The question may arise, why not use belts of stronger than 3,000 pounds? We have no objections, we think that is a good thing, but there has been a lot of experience and a lot of field data collected on the lack of injury in 3,000-pound loop belts in aircraft and in automobile work.

We believe that as the data come in and the public becomes more confident that the belt will not do damage to the human body, that stronger belts can be used.

Col. John Paul Stapp has taken forces of lap belts much higher than the 15 g on the 200-pound man as represented by this 3,000-pound loop blow. I think that gives you an outline.

I would be very happy to answer questions.

Mr. FRIEDEL. Mr. Dye, have you found that the automobile industry has been cooperating because of your studies, by making padded panels, changing the mirrors around, safety door locks? Is that all because of your study, and have they been cooperating with you?

Mr. DYE. We believe we had quite a little to do with it, because we were the first ones to make the studies. We have conducted research on safety door locks. The safety door locks now are quite common practice. Safety door locks are common practice now with all of the automobile manufacturers.

This project was sponsored by the Standard Products of Cleveland, Ohio, a study of improving door locks. They make, I think, around 90 percent of all door locks used on automobiles.

We have made studies on steering wheels, along the line of doing something to the steering wheel, to reduce its injury potential.

We have studied for several years the methods of padding instrument panels, recessing knobs, and the padding of the header, and trying to do something about the windshield.

All of this information is made available to the automobile manufacturers. If they wish it, we send them the reports.

We have also tried to educate the public that something can be done about increasing protection during the crash period, and such articles as that appeared in the Woman's Day magazine, an A. & P. publication, in which we explained that in an automobile crash, it is not just a bunch of luck that lets you walk away. There has been some definite reason why you lived where another person didn't, and that there could be something done about.

Many papers have been given, many talks have been given. We believe that this whole program of crash safety is going to come about through public education. The public has to learn, understand that something can be done, and in that light this year you probably have heard of our Cornell safety car which we are now designing into a show car with some 50 features of research findings, which will be presented to the public in a more or less sugar-coated fashion so that they can see, feel, and understand that safety can be built into an automobile without adversely affecting the styling of the car.

I have heard the expression many times in talks that I have given, "Of course, we can have a crash safety car, but the thing will look like a General Sherman tank or a Red Hill barrel."

The findings of these some 27 different projects are somewhat dry reading when you read the reports, and the reports are bulky and hard to read.

Mr. FRIEDEL. Do you not find in your studies that a lot of the manufacturers of automobiles have been lax in installing these known safety devices, or they have them as optional equipment? I am talking about padded panels, recessed steering wheels, things that have been proven to be safety devices in the industry. They do not make them standard equipment. Have you found that?

Mr. DYE. I don't believe they should be criticized too much on that point. I have nothing to sell except safety. I believe that when the public ask for it, the manufacturers will put it in. But if the public is not ready to receive it, there has not been enough education preceding the presentation of the safety feature, then the public will not buy it, will object to it, and it will not be used.

So that in this program of educating the public to use safety belts, we felt that the only progress made has actually been when a sizable presentation was made to the public, and then the manufacturers came in, one at a time, and offered it as optional equipment.

I think the seat belt, of course, is just a temporary measure; it is a cumbersome thing and it has high nuisance value. Our work in research at the laboratory is aiming toward getting devices which can be installed in the car and will always be ready and will be a part of the car. When you get in such a car you are automatically protected.

In answer to your question, "Should they not be criticized," I don't believe so. After all, they have to make money or they go out of business, and I find them perfectly willing to go along when the public is ready to buy.

Mr. FRIEDEL. Of course, I feel there are a lot of known safety devices that would not be too inconvenient for the public, which the automobile industry should make standard equipment. I know that it is difficult to sell safey devices—even when you try to educate the public regarding their benefits. Testimony before this committee shows that even when safety devices are installed the public is very lax using about using them. That is only human nature.

Well, that is about all I can ask of you, Mr. Dye.

Mr. Moore, would you want to make any comment on any of the following factors in auto design:

Have they studied any of these: Glass body, steering, tires, horsepower, lights, brakes, and weight?

Mr. MOORE. Congressman, that covers a wide scope of territory. I judge everyone is anxious not to hold this session past noon.

We have collected some information regarding the role which some of the devices you mention play in producing injury. We have observed that in automobiles manufactured prior to 1956, that 40 percent of the injured drivers were injured by the steering wheel. Approximately 38 percent of those injured in the right-front seat were injured by contact with the instrument panels as they were designed in that period, as well as 40 percent by contact with the glass.

It has been our policy in our particular research program to confine our attention primarily to establishing the relationships between the patterns of injury, their severity and the automobile structures. We in the medical school feel that we go afield when we attempt to offer engineering solutions to our engineering colleagues.

We feel that they, by the same token, go afield when they go too far in ascribing fatality to a dummy who cannot be hurt.

So we have marked out our area, and we attempt to stay in it.

We do observe, and we are attempting to do studies now which will correlate injuries and their severities to ranges of horsepower. We have a paper which has been published by the highway research board in bulletin 142, in which we relate speed and injury.

We have observed, in substance, in this particular paper that we cannot show that the frequency of dangerous and fatal injury has a significant increase in speeds up to 40 miles per hour. In the range between 40 and 50 miles an hour, the frequency curve of this grade of injury does begin to shift significantly.

As it passes 60 miles an hour, the curve assumes a slope representing a frequency 3 times more likely to produce dangerous and fatal injuries than the angle of the curve in the 0- to 60-mile-an-hour bracket.

In our distribution of accidents according to speed, we have found that 50 percent of the injury-producing accidents occur at impact speeds of less than 40 miles an hour. Seventy percent of these injury-producing accidents involve impact speeds of 50 miles an hour or less.

We judge impact speed on the basis of data submitted by the trooper during the investigation, the trooper we have trained, as well as photographic evidence of the deformations of the structure.

Our analysts have been given extensive photographs from the automobile industry's crash-test program, so that they are able to take a photograph of deformed automobile structure of a precise and known speed and compare it as a yardstick in estimating the correctness of the trooper's estimate.

We have further compared the distribution of speed data we have with the data maintained by the United States Bureau of Public Roads. The data of the Bureau of Public Roads, as you know, are collected on a national, random sample, with mechanically recorded speeds without any evidence of enforcement present in the area of the road in which the speed is reported, so that it represents as honestly as possible what speed the public is traveling.

We feel, in summary, that in relating speed to injury, that for accidents below 40 miles per hour impact speed the grade of injury and the frequency of injury is a direct function of the design of the interior of the structure of the vehicle.

We feel that after the impact passes this speed range, that speed has a role to play along with the design of the structure of the interior of the vehicle.

We have not had an opportunity at the present time to rank this type of injury with horsepower. We do have some observations from one study we published some 2 years ago, and which was read before the American Society of Mechanical Engineers at its annual meeting in Baltimore. In this study we compared automobiles manufactured between 1940 and 1949 with vehicles manufactured between 1950 and 1954. We found that these automobiles were in similar accidents, were being driven in essence by the same age of driver, were being driven at the same ranges of speed, and were having the same seated positions occupied. All the points identified meant that we could compare the two groups as to results, and we found that in the old automobiles, that group of 1940 through 1949 period, we had a significantly higher frequency of no injured people, and we had a significantly higher number of fatalities in the newer, 1950 through 1954 grade of cars.

At no point between the extreme of no injury and fatality did we see the curve of injury pattern of the new group get below the pattern of the old group.

On the basis of this study, which was done with limited data at the time, we had to come to the conclusion that 15 years of vehicular design had not demonstrated any reduction in the injury potential of the vehicle, although its mechanical performance had materially increased.

This paper was very well received, although it was quite critical about the industry, and I feel it had some degree of influence in the decisions they made in 1955 to begin to do development and design in

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the field of delethalizing the interior of the structure, while they also increased its performance characteristics.

As far as commenting on brakes is concerned, I am prone to observe that the coefficient of friction between the tire and the road is one unit of gravity, which means that this tire can be used to stop a vehicle at the rate of 32 feet per second deceleration, that it will be difficult to get a brake—it will be nonproductive to have a braking device which will exceed the coefficient of friction between the tire and the road, because then the tire would more or less begin to skid. And when a tire begins to skid or a car begins to skid, it is immediately out of control.

I have been informed that some of the automobiles offered to the public this year have braking devices that will and can be demonstrated to work at the range of 30 feet per second per second deceleration, which means that the industry is approaching the theoretical maximum of deceleration pattern.

However, the problem that they are primarily concerned with, with brakes, according to my knowledge, is that of designing a device that eliminates heat rapidly enough so that it will reduce brake fade and the brake will be at peak efficiency during the entire stop.

We have not correlated injuries, injury-producing accidents, with variation in brake design, although it could be done, because in our data we maintain we have recorded the make, the model, the body style, the year of manufacture of the automobile. From this it is possible to obtain engineering data as to what design of brake, tire size, or other things were in these cars.

But this has not been done at the present time.

I feel that in dealing with the horsepower question, we are very prone to confuse horsepower as a synonymous term for speed, and the truth is that while horsepower has significantly increased in the past 6 years, the top speed of the automobile has not kept pace nearly with the increase in horsepower.

I believe we have had a great deal of emphasis on advertising, and undoubtedly some of the advertising emphasis has had a bearing on the way the public views horsepower. To date we cannot show in our data that it has significantly increased the speed. We don't find that the new cars are being driven at any remarkably faster speed than old cars, in our sampling.

We do find that the speed of all cars has increased over the past 3 years, but the order of magnitude of that increase is somewhere in the range of 2 miles per hour, average. But it is an upward trend, and it has been a consistent upward trend.

I don't know whether this is good or bad. I am rather prone to think that time is one of the few commodities man is not able to buy, and it is a habitual characteristic of the American citizen to be in a hurry.

Mr. FRIEDEL. One of the faults that I found with the industry is that they have their speedometer reading up to 120 miles an hour, and they say, well, you cannot do 120.

I say, why put on a speedometer reading up to 120? Why not make it 80 or 90? Because, you know, the human being——

Mr. MOORE. It is quite possible that a number of humans are tempted to see if they can reach this point, but I don't think they represent a very significant percentage of our traveling population.

I would like to make an additional comment regarding the question you asked Mr. Dye, or the point Mr. Dye commented on, regarding the shoulder harness.

In our discussions at the Cornell committee, we had available the evidence which I had accumulated during the years when I was Director of Crash Injury Research for the United States Air Force, Division of Flight Safety, and in 1946 I did an evaluation of safety belts and shoulder harness in nondisintegrating aviation, military aviation accidents.

We had over 3,000 accidents in the study to evaluate, and we found that where the pilot had available and used a shoulder harness plus a safety belt, that the fatality rate was less than half that of the cases where the pilot did not use or did not have available a shoulder harness as a restraining device for the torso.

Of course, in translating this knowledge to the automobile, you have to be careful in that the proximity of the head of the pilot to very lethally designed but necessary functional equipment in a cockpit is much closer than it is in the automobile.

Furthermore, in military aviation, the item of cost is not nearly so important as it is in the competitive industry in Detroit.

A shoulder harness cannot be employed in a vehicle unless it has, in my opinion, with it an inertia reel which is an automatic reeling device which allows the upper torso to be extended about 18 inches in order to facilitate reach and comfort.

This device, made up of a set of cogs separated by a butterfly spring, can be designed so that under certain loads of impact the butterfly spring flattens and the cogs come together and lock the device automatically.

Such a device is very costly. It has to be very precisely made, and it has to be very precisely maintained.

I would estimate that to equip an automobile with six sets of shoulder harness and seat belts with inertia reels would add approximately $500 of cost to the vehicle. I think this immediately takes this out of the purchase range of many of the people who buy automobiles and, therefore, we felt that the greatest public service we could do as a university group would be to recommend a device which could be used on all automobiles without major modification of structure, such as increasing the height of the seat back to lead the harness over, and could be purchased in a much more economical range.

I believe that the combination of the belt with delethalized forward structure or forward structure that is actually designed to receive the head without producing injury, is the best compromise possible to date, and the evidence I have from my contact with the industry is that this is the plan of engineering procedure that is followed intensely at the present moment.

Mr. FRIEDEL. Dr. Moore, I gathered that you have been receiving more cooperation from the States to give you the data and statistics you need to make further studies, because when we first met you, you named about 3 or 4, and today you have 8 or 9.

Mr. MOORE. We have a total of 14 States now, and at present we are having States request an opportunity to participate in the program, which is quite different from the method we had to use in prevailing upon the initial States to undertake it.

Mr. FRIEDEL. That is very good.

Mr. MOORE. So that our load of data at the present moment is reaching approximately 12,000 case histories a year, a case history being an automobile involved in an accident.

These vehicles are exposing about 25,000 to 30,000 people to injury-producing forces. So that with the added participation of the States, we will be able to do a great deal more in much less time than we had in the past.

We have had to be very selective and remain in the generic and general range. At present we are able to now very accurately compare the results of 1956 cars with cars manufactured prior to 1956. We have special studies which collect data on current model automobiles as rapidly as possible, so that we can evaluate how effective these engineering changes are in reducing injury when the accident occurs.

But I would like to comment that such a program of data gathering as we have is possible only because the local State groups saw fit to undertake this additional work and provide it. We could never have done it from Cornell, I assure you, and only because of the vision of the State officials were we able to get this data from the only laboratory of which we know where the human is actually being exposed, and that is the highway.

Mr. FRIEDEL. You have been receiving good cooperation from the State of Maryland; have you not?

Mr. MOORE. That is correct. They were the second State, your State was the second State that entered the participation in our program.

Mr. FRIEDEL. Dr. Moore, have you gone into the design of highways, or is that another field?

Mr. MOORE. That is not within the main field of our endeavor. However, we are collecting data on our accident reports which gives us at the present time the number of traffic lanes, the width of the traffic lanes, the width of the shoulders, the width of the median strip, and its design, the condition of the road as to weather and the surface of the road.

We are collecting this because it is available, we have space on our form to get it, and we felt that perhaps as we built enough volume of it, it would be useful to our colleagues in the Bureau of Public Roads and in the highway engineering field.

It is not, however, within the main intent of our program to do intensive work with it, but to collect the data and make it available to people who can use it.

Mr. FRIEDEL. That is one of the phases we are going into. If you had that information available and would furnish it, I believe the committee would appreciate it.

Mr. MOORE. Yes, sir.

Mr. FRIEDEL. Is there anything else? Are there any other questions?

(No response.)

Mr. FRIEDEL. Is there anyone else who wishes to be heard?

(No response.)

Mr. FRIEDEL. We thank you very much, Doctor.

Mr. MOORE. Thank you for the opportunity.

Mr. FRIEDEL. We thank you for your contribution.

(Whereupon, at 11:25 a. m., the subcommittee adjourned, subject to call.)

AUTOMOBILE SEAT BELTS

MONDAY, AUGUST 5, 1957

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON TRAFFIC SAFETY OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The special subcommittee met at 10 a. m., pursuant to call, in room 1334, New House Office Building, Hon. Kenneth A. Roberts (chairman of the subcommittee) presiding.

Mr. ROBERTS. The meeting will please come to order.

This morning the Special Subcommittee on Traffic Safety begins its hearings on the crash worthiness of automobile seat belts.

At the present time there is considerable confusion which exists as to the actual safety value of a seat belt during an automobile accident.

The sole purpose of this phase of the subcommittee's investigation is to try to determine, as far as it is possible, on the basis of the research which has been done—and the knowledge which experts in this field now have, what the safety value of the seat belt actually is in case of an accident.

Needless to say, I was somewhat dismayed to read in this morning's New York Times that the new 1958 automobiles are going to have more of just about everything except the one vital feature which most members of this subcommittee feel is essential to the Nation's health, and that is more builtin safety.

I sincerely hope that the hearings we are beginning this morning will further inform the public on safety features which can be incorporated into an automobile and will encourage the industry voluntarily to build these features into their cars.

The subcommittee is extremely fortunate in having as witnesses for the hearings a remarkable number of men who have done very outstanding research in the field of safety, and especially on seat belts.

Our witness this morning, who is the first witness at these hearings, is Col John P. Stapp, who is director of the Aero Medical Field Laboratory, Holloman Air Development Center, Holloman Air Force Base.

Colonel Stapp, the subcommittee is very pleased that you are able to appear here today. We have heard a great deal about the basic research which you have been doing at Holloman Air Force Base, and we are grateful to have this opportunity to have you appear personally to inform the subcommittee of this work.

Colonel Stapp, if you will come around.

You may proceed with your presentation.

STATEMENT OF COL. JOHN P. STAPP, DIRECTOR, AERO MEDICAL FIELD LABORATORY, HOLLOMAN AIR DEVELOPMENT CENTER, HOLLOMAN AIR FORCE BASE

Colonel STAPP. Thank you, sir.

By way of preliminary summary, I would like to establish two points:

First, that there is no way of assessing or determining injurious or lethal effects of mechanical force except with living subjects, whether they be human or animal.

I have been doing work in this field for the past 12 years in aviation crash research, and for the last 4 years in automobile crash research. I have never found a successful technique for doing an autopsy on a dummy.

And when I read statements from people who say that, on the basis of some mark, scratch or damage to a dummy, there would be death or injury, the only conclusion I can come to is that they must have some special insight, perhaps due to having considerably more in common with the dummy than I have.

The second and positive point which I wish to establish is that in our series of human exposures to mechanical force, corresponding as closely as possible to the automobile crash condition, human subjects protected with a lap belt have been decelerated or stopped with forces up to 4,870 pounds measured in the lap belt, without sustaining any injury.

In terms of deceleration units, this is 27 G's; the duration, one-tenth of a second, which corresponds rather well with a single impact in an automobile crash. And the rate of buildup or rate of onset of the force also is within automobile ranges as measured with dummies.

Understand, we do experiments with dummies, also. We do them in order to measure the forces.

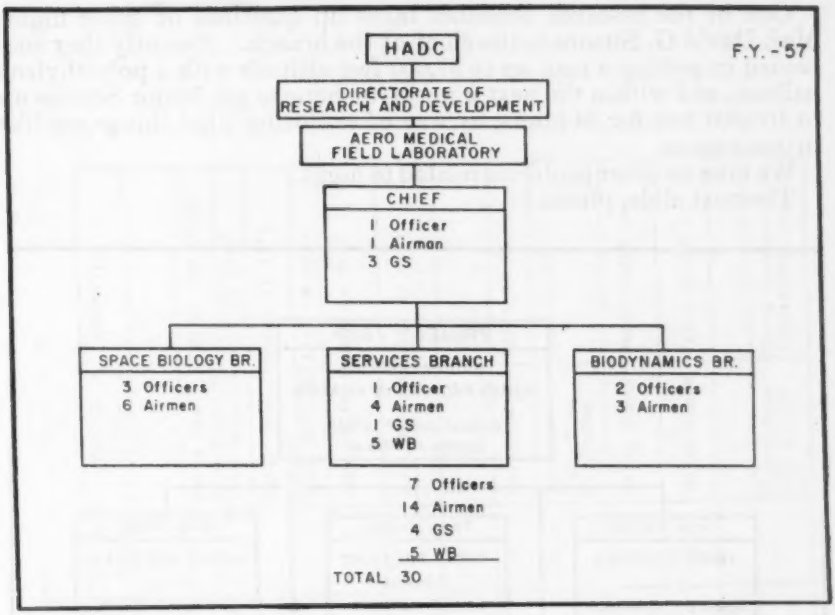
To make this point a little more clear, the NACA did quite a number of crash experiments with airplanes, and they put dummies in the airplanes.

But for one experiment with a Piper Cub, the aircraft hit an embankment and came to approximately 40 G's deceleration, and one of the dummies lost his head. Some individuals commenting on this crash, as they saw it in motion pictures, concluded that because a dummy's head came off, that the same thing would happen to a human.

At about the same time as this NACA test, I performed a test at Edwards Air Force Base in which I sustained 46.2 G's. My head was not restrained, and my head did not come off.

Therefore, we should observe strict limitation in terms of reality in trying to interpret results with anthropomorphic dummies in terms of what a human body would sustain or the manner in which a human body would react to similar forces.

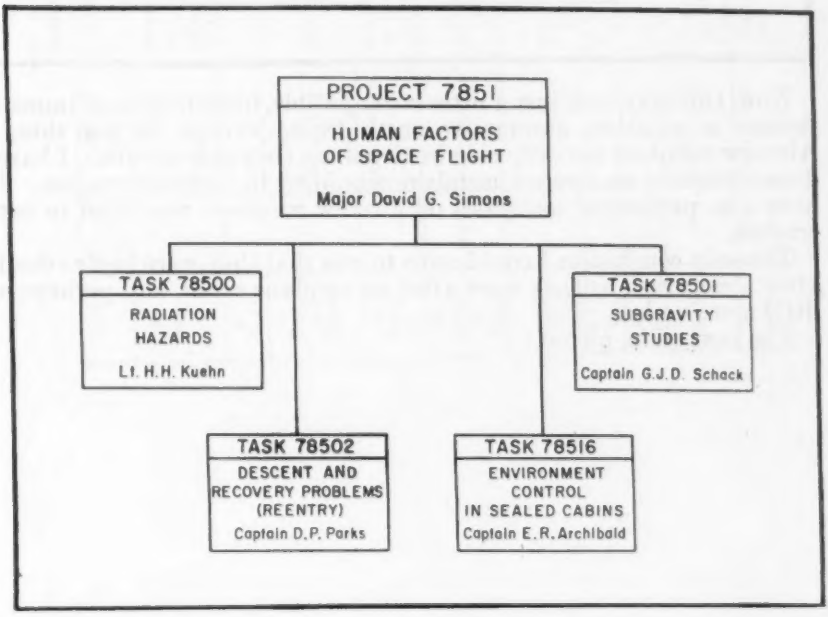
Now I should like to show some motion picture slides.



I would like to introduce you to my laboratory now, since they are not present to be introduced in person.

We have a small laboratory, subdivided into two research branches and a service branch.

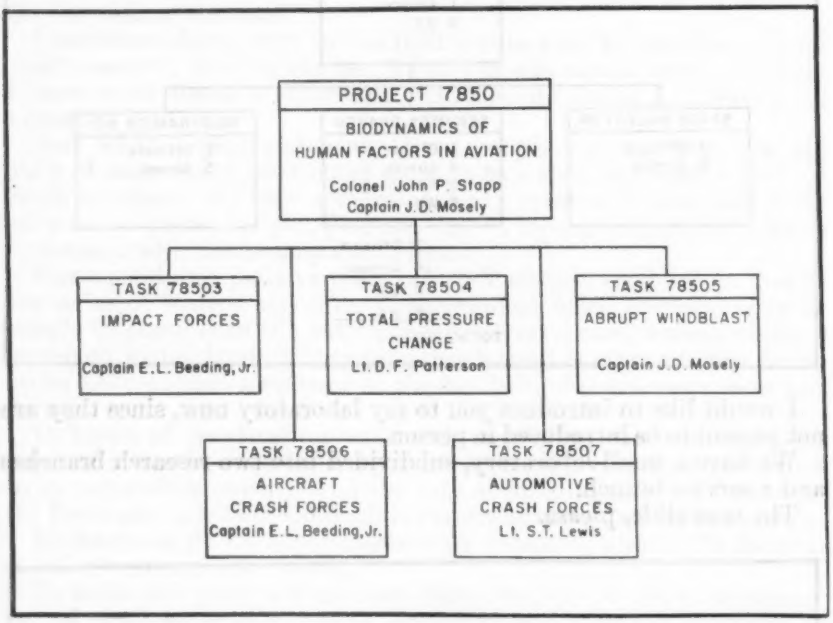
The next slide, please.



One of the research branches takes up questions of space flight. Maj. David G. Simons is the chief of the branch. Recently they succeeded in getting a man up to 97,000 feet altitude with a polyethylene balloon, and within the next 2 weeks we hope to get Major Simons up to 100,000 feet for 24 hours, by way of exploring what things are like in outer space.

We take up other problems related to flight.

The next slide, please.



Now, this may look just a little incompatible, biodynamics of human factors in aviation, automotive crash forces, except for one thing. Aircrew members not only ride in airplanes, they ride in cars. I have done autopsies on aircrew members who died in airplane crashes. I have also performed autopsies on aircrew members who died in car crashes.

The only conclusion I could come to was that they were just as dead after a car crash as they were after an airplane crash, and perhaps a little more useless.

The next slide, please.

AERO MEDICAL FIELD LABORATORY
SCHECULE FOR APRIL 1957

DATE	NO. OF TESTS	TYPE OF TESTS	COMMENTS
1 Mon.	1	Daisy Run	Dummy check out run.
	1	Bopper	26G, 3" lap belt.
2 Tues			
3 Wed.			
4 Thurs	1	Swing seat with hogs. 3" lap belt	Run accomp.
5 Fri.	5	Swing seat with hogs 3" lap belt	Drop Ht var. between 10 and 15 ft.
6 Sat.			
8 Mon.			
9 Tues			
10 Wed.			
11 Thurs.			
12 Fri.			
13 Sat.	1	Windblast	Test conduct. at NOTS, China Lake, Calif.
15 Mon	1	Daisy Run	Dummy check out run

DATE	NO. OF TESTS	TYPE OF TESTS	COMMENTS
16 Tues.			
17 Wed.	2	Daisy Run Seat Cushion	20G at 400 G/sec
		Jump Balloon	Land in seat
18 Thurs.	3	Daisy Runs, Humans	Spine at 45° L
		Jump Balloon	Land in seat
19 Fri.		Jump Balloon	Land in seat
20 Sat.		Jump Balloon	Land in seat
22 Mon.			
23 Tues	3	Daisy Human	Spine at 60° L
24 Wed.	1	Lockheed Skip Flow Generator	Mask failed
25 Thurs.	1	Daisy Dummy	Dummy Check out
26 Fri.	3	Daisy Human	Spine at 90° L
27 Sat.			
29 Mon.	2	Centrifuge 40G for 60 sec.	Tests conducted at Johnsville, Pa.

By way of interest, this is a typical schedule for a month's work by my laboratory as it is lined up in the Holloman range schedule. In addition to what you see on the charts, we also do some centrifuge experiments with the Navy centrifuge at Johnsville, and some very high velocity wind blast experiments at Inyokern or China Lake on the 21,500-foot track there.

On the 13th of April, we made our first test—there it is listed—in which we explored wind blast effects up to 4,000 pounds per square foot. We found some rather interesting results, but just to give you an idea of how much we try to do with our 30 people, the next slide, please.

The El Paso Times
5 AIRMEN MEET DEATH IN CRASH
3-Car Smash Up Injures Two Area Motorists
Flooding Subsides In Texas
Workers Battle During Night To Save Tulsa
Budget Battle Still On
Weary Legislators Facing Serious Financial Problem

Now you want to know, perhaps, why the Air Force undertakes to do automotive crash research. The mission of the Medical Corps is to conserve the fighting strength. Implied in that mission is research of preventive medicine or preventive medical type.

Our foremost problem is in time lost, hospitalization, and the No. 1 cause for admission to Air Force hospitals is automobile crash injuries.

Next slide, please.

AUTO CRASHES

COST TO USAF IN MANPOWER AND DOLLARS

	1953	1954	1955	1956
KILLED	585	608	665	673
INJURED	6245	5852	6083	N.A.
HOSPITALIZED	8520	8500	8070	N.A.
MAN HOURS LOST	3,567,000	3,176,136	3,023,784	3,149,640
HOSPITALIZATION COST	$3,121,125	$2,779,119	$2,645,811	$2,755,935

1 Man day in hospital = $21.00

10,000 Man days in hospital = 100 men for 100 days each = $210,000.00

$210,000.00 = 7.5 % of annual hospitalization cost for 1956

If savings in hospital costs = 20 % = $550,000.00

If savings in lives = 20 % = 125 men

Here we have them.

The loss of life in automobile crashes is only second to the loss of life in airplane crashes, and both of these items provide the leading cause of death in the Air Force.

Of course, we are dealing largely with the younger age group, and this corresponds pretty well to the national record where, up to the age of 20, 40 percent of the deaths are due to accidental causes.

Antibiotics did away with the infectious diseases, pretty largely, as a substantial cause of death, and it has been supplanted by the tremendous increase in injury and death from automobile crashes.

These that we list are only the direct costs. I omitted one. You can take these 637 funerals and multiply them by $27,000, and you get the average cost of a dead man in the United States Air Force. Those are the direct costs.

That does not take into account this replacement, and the amount that has to be spent in training a replacement. It does not take into account a host of indirect losses, not to mention a uselessly lost life from an American family.

And I think if you take the figures for the Korean war and the losses we sustained there from enemy action, they were considerably outnumbered by vehicular accident deaths and injuries occurring in

all parts of the United States Air Force at the time of the Korean war.

So that it begins to look as though a man would be a little safer in a bomber strafing the North Koreans than he would be in a vehicle on the streets of the United States.

The next question is, How did I happen to get involved with doing automobile crash research? This was more or less by default.

In September of 1953, I was called in for a conference at the School of Aviation Medicine. They were aware of this problem. There was no direct way in the ARDC mission, air research and development plan mission, that they could justify the funding and starting of an automobile crash research program, but they thought they could get it under preventive surgery as part of a mission of the School of Aviation Medicine.

The effort to get a joint program between the School of Aviation Medicine and my laboratory went on for about 6 months, and then Colonel Talbott, Chief of Human Factors, ARDC, said the problem is urgent, that is enough fooling around, let's get to work on it.

So I appointed a project officer, who went to all Government and civilian agencies that could possibly be involved in automobile crash research, and coordinated with them and found that the special aspect we were interested in was not covered by anyone else; that is to say, the biological testing of crash forces as they would be found in automobiles.

And, with everyone's concurrence, we went to work. It was a rather apt choice that our laboratory should be selected, because we had a considerable fund of information applicable to this problem from some 9 years prior of our airplane crash research.

We had worked out parameters of human tolerance for aircraft, and this constituted a minor enough problem in our estimation that we made it a task under one of our projects.

We have attacked the problem from the following rationale: First, to gather statistics from the Air Force Ground Safety Office, from Cornell crash injury research, and other sources, as to what were the most prevalent angles and directions and modes of car crashes.

Second, to reproduce some of these, the principal ones, with using salvage automobiles from Air Force salvage yards. These could be pushed or towed or shoved into each other or into appropriate obstacles, and the forces measured on anthropomorphic dummies.

Third, the third step, to obtain devices that would permit human subjects to be safely exposed to decelerative forces such as would be encountered in the automobile crashes to be tested, and to progressively expose them until we found a tolerance limit, using the protective devices most appropriate for cars.

I did not bring any belts because I am not in the business of developing belts. I am merely trying to find out tolerance limits, and what the human can take.

Then, having completed, or at least gotten underway, human tests with these devices, the next step was to find injurious and lethal effects with devices, the same devices actually, where an animal subject would be exposed to greater forces than we would risk with a human.

The animal we chose for these experiments is the hog. We anesthetized the hogs, of course, for every test, and in nearly all instances

when the test was over and all appropriate scientific measurements were made without permitting the animal to recover consciousness, we put the animal out and did the autopsy.

I make no special plea about doing animal experimentation, because I know that animal lovers are very fond of telling stories about how an animal would lay down his life for his master, and I think that when the Air Force purchases a hog to do experiments with, that hog is being given the opportunity to lay down its life for all of its masters.

We consider them to be good soldiers, and we give them the very best care that we possibly can, and we do our experiments in strict accordance with the American Medical Association's rules for animal experimentation.

And with a limited number of animal experiments, we can assure the safety of a practically unlimited number of human experiments, of human volunteers, and we can cover the full spectrum of tolerance, injury, death, extrapolating the animal results to human terms.

And even that we do very carefully, and I can assure you if there are any techniques by which we could determine when a dummy is injured or dead, we would not do any animal experiments.

The final phase of this experimental program, which we have not started on yet, will be to take automobiles, put human volunteers in them, and carry out a series of progressive crashes, using as criteria for the forces involved the progressive series of experiments we did with the humans, and observing as safe limits the force ranges into which we go with our animal experiments.

We are the only agency doing animal experiments because, well, about 2 years ago I was at the Ford Motor Co., and they were doing tests on their deep dish steering wheel, and they were using something that looked like a cotton ball and swinging it into the steering wheel and measuring the forces.

I persuaded them to try an animal experiment, and in order that we could get it done that day, why, several of us pitched in about $20 apiece to buy a hog for the Ford Co. And they were all animated and happy at the prospect of finding something out. The doctor had his anesthetic ready.

But they came back crestfallen because their company lawyer and public relations people said, "No animal experiments at the Ford plant." And it seems to be a touchy subject at all the motor companies.

We have cooperated freely with them, and once a year they gather at Holloman and we show them a field day of experiments, and give them all the most recent results.

That provides the industry with a source of indispensable information for designing safety devices like steering wheels and lap belts.

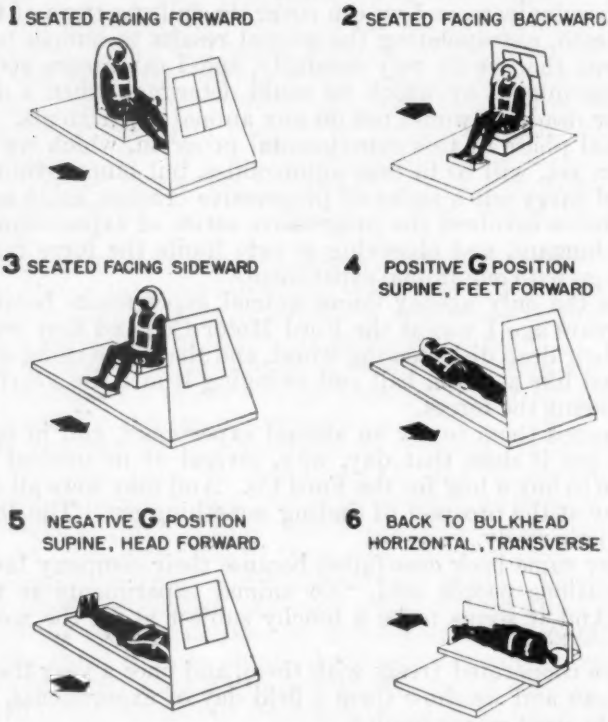
Then the final phase of our program where we are using an automobile to crash human subjects is greatly facilitated by a gift from General Motors. Howard Gandelot and his department in General Motors have devised a snubber. This is something like a huge shock absorber, and a vehicle can be attached to it with a long cable. The vehicle can be towed up to the desired speed, the tow cable is friable and parts, the vehicle goes to the end of its tether and is pulled short, and forces can be measured.

This seems a little safer for human experimentation, to me, than running an automobile into a stone wall. I do not know whether we will get to that one or not, but we might. It takes pretty hardy volunteers.

I am very grateful to the General Motors Co. for making us this gift, which will facilitate getting results for them, particularly this year when I would say that anything the Air Force gets from General Motors has got to be good. [Laughter.]

If we can show the next slide, I will begin discussing some of what we have learned.

HUMAN BODY POSITION VARIATIONS
FOR LINEAR DECELERATION



As far as aviation is concerned, these are the six cardinal positions of the human body that require evaluation, and it requires design of protective restraints in terms of crashes.

We have explored this whole series of positions by means of 254 rocket sled experiments that were performed at Edwards Air Force Base in California, between March of 1947 and June of 1951.

The first two positions, which are applicable to passengers and operating crews, we explored with humans.

With the backward-facing position, we went up to forces of as high as 40 *G*'s or 40 times the body weight—that would be 6,000 pounds

for a 150-pound man—and found no harm done with a force evenly distributed over the back surface of the body ramming into the back of the seat.

And, of all positions, that seems to be the most reliable and safest, with the force distributed over the body area.

With the forward-facing position, we found we could go as high or higher, providing we use enough straps. That included, as you see, shoulder straps, chest strap, lap belt, and you can see the corners of the tiedown strap going down between the legs to the seat.

While we could ask a trained pilot to wear something like that, we do not go so far as to ask passengers to do it. We just turn their seats around in Air Force transports.

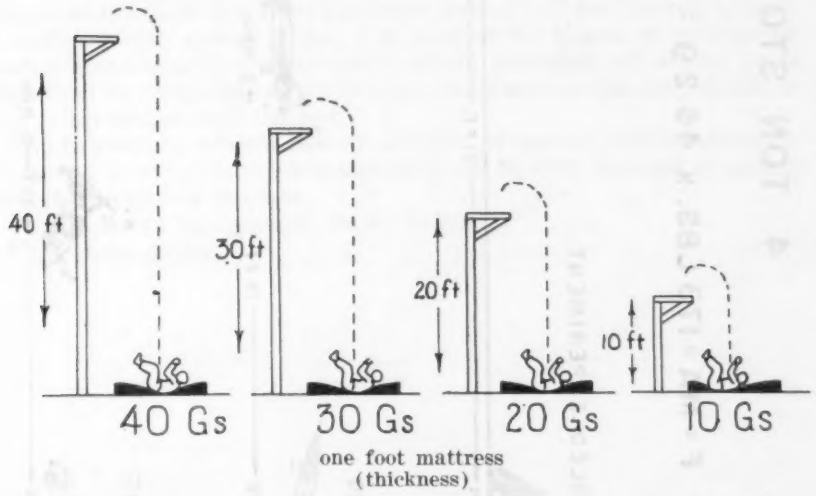
The other positions we explored largely with experiments using anesthetized chimpanzees.

You wonder why I use hogs—hogs and chimpanzees? Well, man is somewhere between the hog and the chimpanzee. Some people are more like hogs; others are more like chimpanzees.

The chimpanzee has about the same general shape and size, slightly less size than a human, and in the fore and aft position, from chest to back, has about the same tolerances and limits; and in the up and down position, in other words, from head to seat, while in a seated position, and from seat to head, champanzees, their vertebral column and general structure is about 2½ times as strong as a man's.

Therefore, we do not make too close comparison there.

The next slide, please.



I have talked about *G*'s. Let's get straight what a *G* is, in simple terms.

If you take a mattress 1 foot thick, let a man go through a fall of 10 feet and then be stopped in 1 foot, the force of his stop will be roughly in inverse ratio to the distance he falls. If he falls 10 feet and stops in 1 foot, 10 *G*'s.

If he jumps 20 feet, stops in 1 foot, 20 *G*'s, 20 times his body weight.

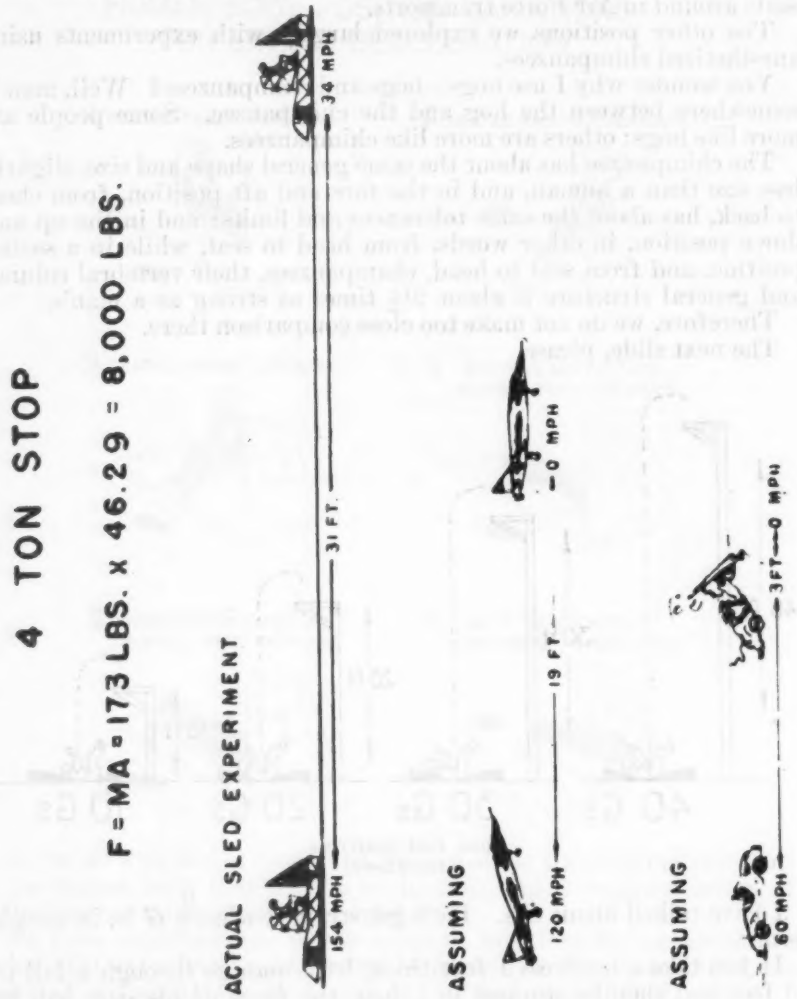
And this is just a rule of thumb. It is presented mainly for clarity,

and not for purest criticisms from engineers. Thirty feet, 30 *G*'s; 40 feet, 40 *G*'s.

Hugh DeHaven reported in the instance of a man falling off a water tower 190 feet tall, landing in loose gravel, causing a print 9 inches deep in the gravel, and sustaining some fractures but living over it.

The calculated force of that fall turned out to be in the order of 180 to 190 *G*'s, and that was looked upon skeptically. But since that day, we have verified this experimentally.

The next slide, please.



Mr. ROBERTS. Colonel, will these charts and slides be available for the record?

Colonel STAPP. We can allow prints to be made of them.

Mr. ROBERTS. Well, could you supply us with those prints?

Colonel STAPP. Yes, sir, we can.

Mr. ROBERTS. Without objection on the part of the subcommittee, I would like for those to be incorporated in the record.

Colonel STAPP. Very well, sir.

The last experiment that we did at Edwards on June 6 of 1951 was one in which a rocket sled in 5 seconds was propelled up to a speed of 180 miles an hour, allowed to coast until it slowed down to 154 miles an hour. It then entered mechanical friction brakes which, in a distance of 31 feet, slowed it down to 34 miles an hour, which give us a speed loss of 120 miles an hour in a distance of 31 feet, and in one-quarter of a second duration.

If we take this 120-mile-an-hour stopping distance at the peak of which the subject sustained 46.2 of these *G*'s, or a load measurement in his harness of 8,000 pounds, if we assume a velocity of 120 miles an hour and 8,000 pounds of force in going to a full stop, then the stopping distance would be 19 feet. This would be equivalent to taking a jet aircraft at its usual landing speed, and stopping it in about one-third of its length. And that, you can walk away from. I know, because I did.

If we were to take a 60-mile-an-hour velocity and slow down at such a rate that an 8,000-pound force would be sustained, then that stopping distance becomes 3 feet. The time, of course, is correspondingly shortened. But we can get 8,000 pounds of force in a 3-foot stop from an automobile at 60 miles an hour.

And since numerous experiments with automobiles have shown that those marshmallow fronts will collapse from 2 to 3 feet during a head-on collision with a solid object, it is possible for a man to walk away from a 60-mile-an-hour automobile crash, provided, of course, he is restrained as adequately as we had the restraints on this sled, shoulder straps, lap belt, and all the rest.

And this would indicate that application of some of this information we gained in aviation crash research would be very fruitful in saving lives in automobile crashes.

With this as a background, we set to work.

Next slide, please.

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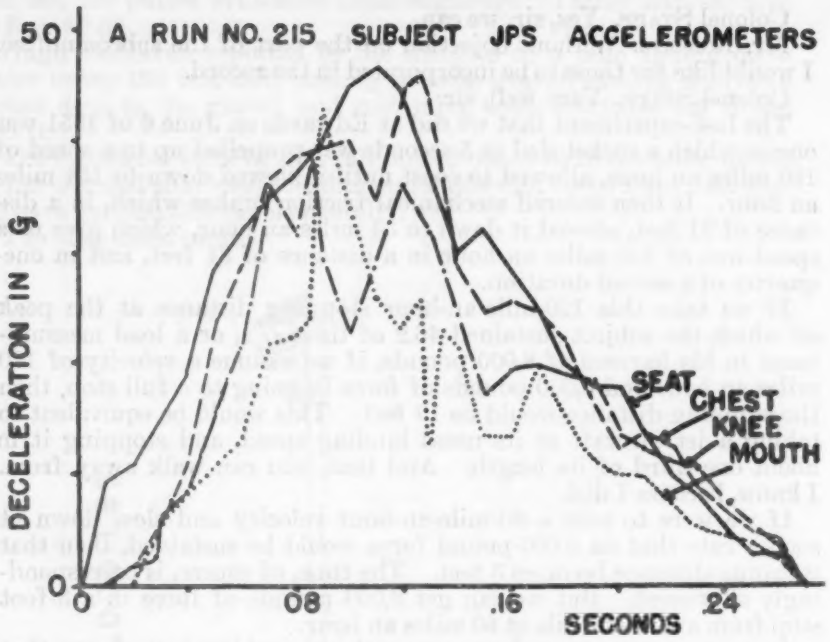


Here is the actual graphic data we obtained in that crash. The duration, a quarter of a second. Well, anyway, the speed goes up to 46.2 *G*'s measured on the chest. We had accelerometers or pickup devices on the under side of the seat, fastened to the subject's chest, on his right knee, and held an adapter between the teeth.

We did not measure rotational forces of the head. That would be overinterpreting a linear accelerometer's traits.

Next slide, please.

TYPICAL CALCULATIONS OF DECELERATION

V = INITIAL VELOCITY = 644 FT/SEC

S = STOPPING DISTANCE = 100 FT.

g = 32.2 FT/SEC^2

A = AVERAGE DECELERATION = $\frac{V_i^2}{2gS} = \frac{(644)^2}{2 \times 32.2 \times 100} = 64.4\,g$

M = SUBJECT'S WEIGHT = 100 LBS.

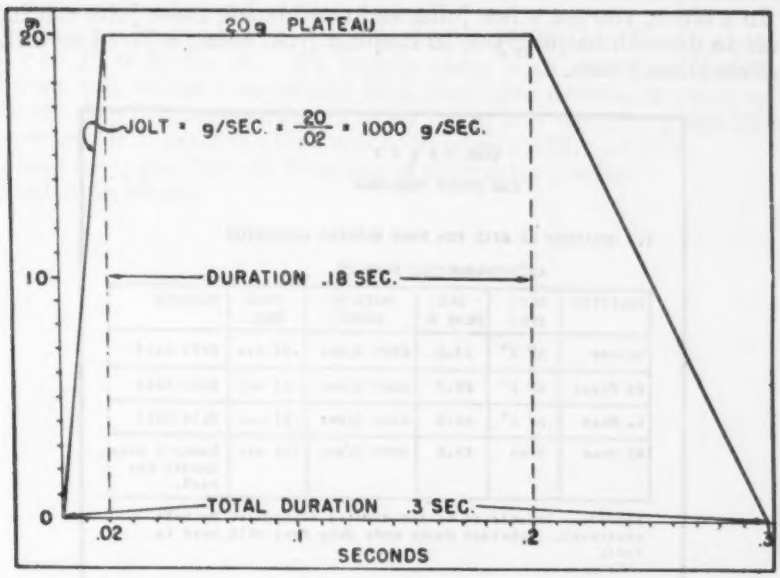
F = MA = 64.4 x 100 = 6,440 LBS.

Here is how we figure the data we get from these graphs. Suppose we have an initial velocity of 644 feet per second. That is in the order of 400 miles an hour. But we have done a number of experiments in a lethal range at 650 miles an hour.

Suppose we have a stopping distance of 100 feet. A G is 32.2 feet a second per second, or the amount of force required to shove your body up to that speed in that 1 second. Then we can use a formula I will derive, but you can take for granted, of $\frac{V^2}{2GS}$. S is the stopping distance, and V is velocity, and 2 times G times the stopping distance will give us an average of 64.4 G's, or the 100 pounds, being the weight of the subject. And if we take the subject's weight and multiply it by the force, mass times the acceleration, we get 6,440 pounds, and that would be the force with which the subject would hit the harness during such a deceleration.

The next slide, please.

TYPICAL GRAPH OF DECELERATION



Then, looking at a diagrammatic representation of the record similar to the one I just showed you, say we assume a 20 G peak, plateau. We analyze these records in terms of the following factors:

The total magnitude of force, the duration of the force—we have several points that interest us in the duration. The total duration would be from here to here, but the duration of the plateau would be from here to here—and a third portion of the motion we call the jolt, the rate of onset.

When you are in a wagon and it goes over a rock, it goes up abruptly and down abruptly, you change rate of acceleration, and you will get a jolt. When you are seated in a rocket sled and it hits mechanical friction brakes at high velocity and is abruptly slowed down, until it reaches a steady state of slowing down, a steady rate of slowing down,

you get a jolt. And we found that the jolt, that is, the time that it takes from the onset of force until you reach this level state or else start a decay of the force, that that unit, that factor, is highly important in terms of tolerance.

And all of you know that you can get in a car and drive across rails in a railroad yard at 45 miles an hour and get some jolting, but no injuries. If you took an iron-wheeled vehicle with no springs and a metal bed, had yourself tied to that metal bed, and went across at 45 miles an hour, you would be lucky enough not to be killed by the jolting that you would get.

The marvelous system of pneumatic tires, springs, other devices that the automobile industry has developed, to take the force out of these jolts, attenuate them and translate abrupt forces into longer duration, softer forces, and to absorb the force as heat, and springs and other mechanisms, that is the difference between a mildly uncomfortable ride across rough objects and an injurious ride across the same obstacles.

I am telling you these things in order to try to get across the idea of what a jolt is like.

In a crash, you get a few jolts, and modulating those jolts can have a lot to do with helping you in keeping from being injured or killed.

Next slide, please.

TASK 7 8 5 0 7

CAR CRASH RESEARCH

1. HOLLOMAN 33 MILE PER HOUR BARRIER COLLISION

ANTHROPOMORPHIC DUMMIES

POSITION	SEAT BELT	DEC. PEAK G	RATE OF ONSET	PEAK DUR.	REMARKS
Driver	AF 3"	84.0	6000 G/sec	.02 sec	Belt held
Rt Front	AF 3"	87.0	6500 G/sec	.01 sec	Belt Held
L. Rear	AF 3"	48.0	5000 G/sec	.01 sec	Belt Held
Rt Rear	None	89.8	6000 G/sec	.01 sec	Dummy's head dented car roof.

Secondary impacts of belted dummies attenuated by belt restraint. Unbelted dummy made deep dent with head in roof.

2. UCLA 40 MILE PER HOUR BARRIER COLLISION

(Contract AF 29(600)-920)

POSITION	BELT	DEC. G	RATE OF ONSET	DUR. SEC.	FORCE LBS
Vehicle Frame	-	60.0	7000 G/sec	.002	-
Rt Front	Yes	-	-	-	5000
Rt Rear	Yes	-	-	-	6000
Driver	No	-	-	-	-

Driver, chest smashed steering wheel.
Rt front belt buckle broke, lacerated dummy's abdomen deeply.
Rt Rear: Belt effective, no damage

Now to get to the actual experiments that have been performed at Holloman:

This is a typical selected automobile barrier collision. These positions refer to dummies, four of them in the vehicle. We were using 3-inch belts because we were using them on the humans. It is very likely that a 2-inch belt will save your life to the same exposures of force that a 3-inch belt will, but it is a little more comfortable to do a crash experiment with a 3-inch belt than with a 2-inch belt, and rather than to risk having the subjects refuse to volunteer for these painful experiments up to a maximum, we use 3-inch belts.

After we have found limits with 3-inch belts, we will go back to 2-inch belt and see how far the boys will go, and that is only a comfort factor, not a factor of limit of survival or injury.

We found high rates of onset which need attenuating by some force-absorbing or force-deploying mechanism. We found fairly high forces, and of short durations. And we certainly found this: That the rear dummy, with no belt, dented the roof of the car with his head. I believe that Mr. Moore will tell you that 20 percent of the people killed in automobile crashes are found outside the vehicle, and a belt can certainly hold an individual in place.

We have a contract with the University of California of Los Angeles to do tests for us. We supply them with Air Force salvage vehicles, and utilize a capability that they have developed there, and with the fine instrumentation, and so forth, and we have given them a contract for 25 crashes which will be finished by June of 1958.

These are typical results from one of their early crashes.

Next slide, please.

TASK 7 8 5 0 7

CAR CRASH RESEARCH

3. UNIVERSITY OF MINNESOTA ENERGY ABSORBING BUMPER AND ROLL OVER STRUCTURE DEVELOPMENT

(AF Contract 29(600)-831)

A. 40 Mile per Hour Weapons Carrier Impact Test of Energy Absorbing Bumper

POSITION	DECELERATION G	RATE OF ONSET G/SEC	DURATION SEC
Bumper	65.0	40,000	.005
Dr, Dummy	30.0	3,000	.002

B. 40 Mile per Hour Turnover Test, Weapons Carrier

1. Vehicle did two 360° rolls without impacting driver against ground.

Items A & B designed for demountable retrofit.

4. HOLLOMAN STEERING WHEEL EXPERIMENT, ANESTHETIZED HOG, SWING DECELERATION AT

HOG WT LBS	SEAT WT LBS	DROP HT	VELOCITY AT IMPACT	DEC. CHEST G'S	ENERGY AT IMPACT	RESULT
290	87	48"	14 ft/sec	27.7	1508 ft/lbs	Fatal

Steering wheel lower rim impinged on abdomen. Liver lacerated, fatal hemorrhage.

The University of Minnesota has undertaken to develop two items for us, which are applicable to rigid-frame vehicles, particularly also with vehicles with open tops. One is an energy-absorbing bumper, built very much like an airplane shock absorber, and is between the frame of the bumper and the car. There are two of them on the bumper as presently developed. And they considerably reduce the force's driving where the dummy is sitting.

On this 40-mile-an-hour crash, the force measure at the bumper was 65 *G*'s; in our 33-mile-an-hour crash, the forces measured on the dummies were on the order of 50 *G*'s. But now we measure 30 *G*'s on the dummy, and the rate of onset has been attenuated down from the 0.005 *G* per second measured on the 33-mile-an-hour crashes we did at Holloman, down to 0.002 *G* per second.

The other item we wanted to develop was a demountable turnover device for open-top vehicles, because it would not be wise to tie people in, in a vehicle which, when it turned over, would crush them.

So they developed a turnover structure which has been tested at 40 miles an hour, that was the speed that we specified, and the University of Minnesota has done several tests there, and is continuing the program.

Then this is a typical experiment done at Holloman with a hog, anesthetized hog, mounted in a sort of garden swing, which is allowed to drop from a 4-foot height and is then snubbed by a cable.

The hog was held in only by tapes, not by any belts, and he was allowed to impinge against the steering wheel.

We did tests with all types of steering wheels, and this was the only biological testing that was done in the development of these malleable-spoke steering wheels that are now being used in vehicles, manufactured by the various automobile companies.

And we found that the deformation of the spokes, the bending of the steering wheel, took up energy to the extent of about 50 percent of the force, and steering wheels would be deployed forward as much as 6 inches in some models, and that would go a long way to protect a driver from a ruptured spleen and a lacerated liver or crushed chest.

The next slide, please.

LAP BELT TESTS

DAISY TRACK

1 a. HT. b. WT. c. AGE	2 VELOCITY FT/SEC	3 STOPPING DISTANCE IN.	4 DECELERATION AT LAPBELT G'S	5 F=MA LBS.	6 BELT PSI	7 RESULT
a. 67" b. 173 c. 47	28	19.78	9.0	1557	28.8	Negative
a. 67" b. 173 c. 47	28	19.8	7.3	1263	23.4	Negative
a. 70" b. 159 c. 28	24.8	18.9	10.8	1720	38.2	Muscle soreness, neck
a. 70" b. 155 c. 19	28.7	19.6	11.2	1740	41.40	Abrasions, contusions, hips.
a. 64" b. 145 c. 20	28.2	18.6	11.8	1710	42.8	Abdominal pain, abrasions, hips.
a. 70" b. 130 c. 28	29.6	14.3	17.0	2210	58.1	Abdominal pain, muscles sore-one month
a. 73" b. 185 c. 28	25.7	14.2	13.6	2515	44.2	Abdominal pain, muscles sore-one month 3 days in hospital

What we call the Daisy track, named after the Daisy air gun, is a 120-foot track, 2 rails, 5 feet apart, with a sled mounted on these 2 rails on slippers. It can be propelled forward either by powder catapults or by an air gun, and a probe on the front of this sled enters a cylinder in a fixed water brake, and by pushing through a membrane it begins to compress water inside this cylinder and squirt it out of the holes of the side of the cylinder.

The water inertia during the process of water being squirted out of 250 holes, served as braking force. The braking force can be regulated by putting chokes in these holes or else by plugging, and we can get very accurate patterns of deceleration up to a 4-foot distance with this device.

We took a number of volunteer human subjects. Their ages, heights, and weights are listed. And at fairly low velocity, in the

order of between 25 and 30 feet per second, that would be about 20 miles an hour, we let them stop in this distance in inches, by means of this cylinder water brake.

We measured the forces progressively larger on the lap belts, and the force in pounds; by weighing the subject, taking the subject's weight times the lap belt measurement of acceleration, and taking the area of the lap belt, we worked out the pounds per square inch.

And here we have comments as to the status of the subject. This is much better than we have ever been able to get from a dummy, because somehow or other they never complain. And here, at some 13.6 *G*'s, 3,811 pounds, this rather sensitive experiment in botany complained about some effects, and spent some time in the hospital, 3 days in the hospital, rather needlessly. We considered him a rather sensitive subject, and never used him again.

HUMAN TOLERANCE TO LAP BELT RESTRAINT

SWING TEST

			SEAT ACCELEROMETER			LAP BELT ACCELEROMETER			CHEST ACCELEROMETER			KNEE ACCELEROMETER		
TEST NO.	SUBJECT WT.	VELOCITY FT/SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC
2	160	16.19	1650	24.75	.001	475	15.7	.001	1040	15.6	.002	516	15.5	.001
5	160	16.19	1595	31.9	.001	948	21.7	.001	488	17.1	.001	475	19.0	.1
8	138	16.19	1613	24.2	.002	648	16.2	.004	850	17.0	.007	300	13.4	.004
9	178	16.33	1388	25.0	.002	896	19.0	.002	1246	18.0	.003	713	20.0	.004
10	165	16.62	1841	28.0	.002	837	22.0	.001	859	20.0	.003	664	19.0	.005

We used a device that also gave briefer but rather decelerated force, using this garden swing attached to a cable with a concrete anchor, to bring the swing to a halt.

The subject would be pitched against the lap belt, and we could measure the forces; and with higher rates of onset which we were interested in, a group of volunteers were exposed to forces, and we made measurements on the lap belt, on the chest, on the knee.

The ones that we consider significant on the lap belt, we got up to 22 *G*'s on the lap belt, 22 times the 165 pounds of the man. That is still less than 4,000 pounds.

The next slide, please.

STEERING WHEEL IMPACT TEST

				CHEST ACCELEROMETER		
TEST NO.	SUBJECT WT.	VELOCITY FT/SEC	FT. POUNDS AT IMPACT	RATE OF ONSET	PEAK G	DURATION IN SEC
6	163	25	1832	2300	23.8	.001
8	185	20	905	1800	18.8	.001
10	153	25	1920	2400	17.32	.001
11	164	20	1004	1800	22.3	.002
12	150	25	1967	2400	19.8	.004

This is another set of our steering wheel impact test data on hogs. Let us go on to the next slide.

HUMAN TOLERANCE TO LAP BELT RESTRAINT[1]

BOPPER

			SEAT ACCELEROMETER			LAP BELT ACCELEROMETER			CHEST ACCELEROMETER			KNEE ACCELEROMETER		
TEST NO.	SUBJECT WT.	VELOCITY FT/SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC	RATE OF ONSET	PEAK G	DURATION IN SEC
2	160	19	524	18	.005	478	16	.006	100	24	.005	300	8	.003
3	136	19	540	16	.01	558	20	.003	300	17	.004	500	8	.001

Now what we call the bopper is a short-cord catapult. This thing is about 25 feet long, has 2 rails, 2 feet apart, a seat is mounted on it. It can be pulled back like a slingshot, and when a trigger is pulled the rubber bands can accelerate to a speed of as much as 18 miles an hour in a distance of about 18 feet, and then it can be stopped in a few inches; and the subject, held by a lap belt, is flung forward, and we obtain measurements of the forces involved.

And here, lap belts we got up to 20 *G*'s, using the—this is a lightweight subject.

The next slide, please.

MAN–LAP BELT–INCOMPLETE
4800 LBS FORCE TOLERATED
3" LAP BELT

The best we have done was done with the "bopper" device, and Lieutenant Lewis, project officer, took a ride, that was about as much as he could get out of the equipment, and he got up to 27 *G*'s, or a measured force, actually, of 4,870 pounds. He was whipped forward with his chin beyond his knees, with sufficient force to cause some persistent pain in his back.

There was a momentary shock due to impact against the abdomen, but this all occurred in a matter of about 15 to 30 seconds, after which he was talking to people as they measured his blood pressure, took an electrocardiograph, and so forth, and so forth.

And that is why we called it incomplete. We have not gotten to a point yet where we found any irreversible signs or any beginning of damage, even at 4,870 pounds of load against a lap belt.

Other witnesses will give you the forces that they have measured on lap belts in very numerous experiments at the automobile proving grounds, and you can bear this figure in mind when you see what they present, and use it as a more or less rough figure that we have at present, and get some idea of how many crashes people could go through without any injury, if the force experienced in the crash is 4,800 pounds or less.

The next slide, please.

TASK 7 8 5 0 7

CAR CRASH

EXPERIMENTS TO DATE:

Vehicle Barrier Collision	6
Vehicle Roll Over	10
Steering Wheel	12
Lap Belt Tolerance:	
a. Swing	19
b. Bopper	6
c. Daisy Track	5
TOTAL	58

1. 35-45 miles per hour barrier collision forces measured on dummies in survivable range.

2. Uninjured tolerance to 26.0 G or 4587 lbs force on 3" lap belt, human subject.

3. Ductile spoke steering wheel attenuates impact by 50% on hog subjects in 1000-5000 ft lbs impact range.

4. Hydraulic energy absorbing bumper attenuates force of 40 mph impact by half.

This is a summary of the tests we have done.

In the past 2 months, we have done lethal and injurious limit experiments with that swing, using the anesthetized hogs. We have gotten to 40 *G*'s with hogs, or 40 times the body weight of a hog, which would be between 150 and 200 pounds—we choose hogs of human size—before we produced any definite injuries to lungs, heart, abdominal organs.

These injuries consisted of small hemorrhagic spots. They were not necessarily persistent or certainly not lethal. We had to go to something in the order of 50 *G*'s to begin to produce lethal injuries. That was with the lap belt alone.

This, of course, has been superseded by the 27-*G* experiment. These are rough summaries of what have been done to date. Except that this one, this is one *G* less than the limit we have got to.

The next slide, please.

TASK 7 8 5 0 1

CAR CRASH

APPLICATION OF RESULTS

Consultation and Evaluation Supplied to:

1. USAF Ground Safety
2. SAE Seat Belt Committee
3. Commission on Accidental Trauma, Armed Forces Epidemiology Board
4. Cornell Crash Injury Research, Automotive
5. American Medical Association

PUBLICATIONS

1. Criteria For Crash Protection In Armed Forces Ground Vehicles
2. Human Tolerance to Safety Belt Restraint
3. Experiments Conducted On A Swing Device For Determining Human Tolerance To Lap Belt Type Deceleration
4. A Crash Restraint Demonstrator
5. Evaluation Of A Hydraulic Bumper And Rollover Structures Capable Of Retrofit

FOR F Y '58

1. Snub Cable Vehicle Decelerator
2. Improved Swing Decelerator
3. Lethal and Injurious Limits for Lap Belt Deceleration, Hog Subjects
4. Vehicle to Vehicle Decelerations
5. Complete Human Tolerance Determinations

Here is what we have done with our results. They have been reported to our partners in the business, United States Air Force, ground safety. I am a member of the Society of Automotive Engineers' seat belt committee, and this has been no impediment to a direct transmission of our information to the Society of Automotive Engineers and, through them, to the industry.

We have worked and reported to, worked with and reported to, the Commission on Accidental Trauma of the Armed Forces Epidemiology Board. We interchange information freely with the Cornell crash injury research, automotive, and various commissions and members of the American Medical Association.

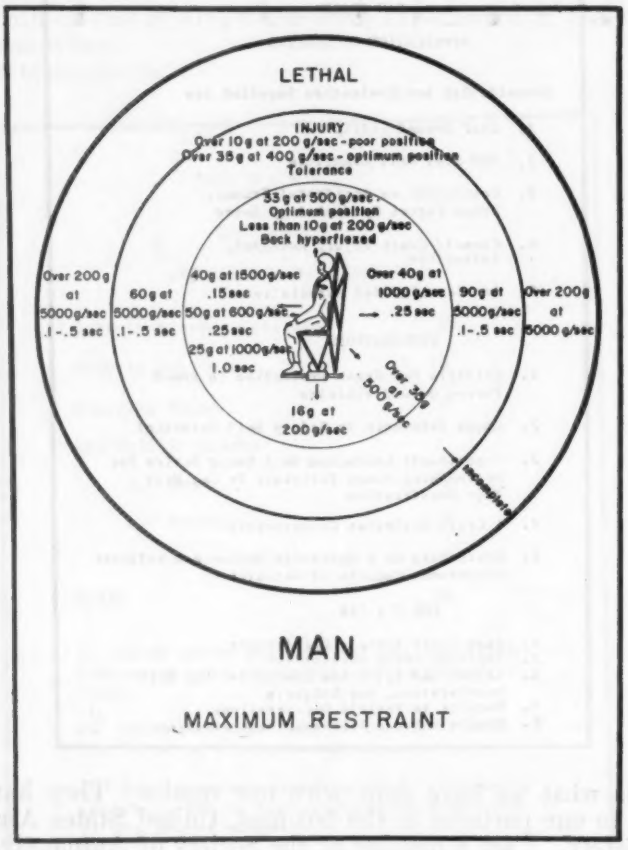
We have turned out these publications and have two more in the mill right now that will be out this fall, and here is what we propose to do during the coming fiscal year.

We will take the snub cable vehicle decelerator and go the limit with human subjects, snubbing actual cars.

We are making an improved swing decelerator which will be suitable for putting a car seat on.

We will continue the lethal and injurious limits for lap-belt experiments, for which we are using anesthetized hogs, and we are going as far as we can with all the devices on determining human tolerance to two sizes of lap belts, the 3-inch width and 2-inch width.

The next slide, please.


LETHAL
INJURY
Over 10 g at 200 g/sec - poor position
Over 38 g at 400 g/sec - optimum position
Tolerance
35 g at 500 g/sec -
Optimum position
Less than 10 g at 200 g/sec
Back hyperflexed
Over 200 g at 5000 g/sec .1-.5 sec
60 g at 5000 g/sec .1-.5 sec
40g at 1500g/sec .15 sec
50 g at 600 g/sec .25 sec
25g at 1000g/sec 1.0 sec
Over 40g at 1000 g/sec .25 sec
90g at 5000g/sec .1-.5 sec
Over 200g at 5000 g/sec
16g at 200 g/sec
Over 35g at 500 g/sec
incomplete
MAN
MAXIMUM RESTRAINT

In the meantime, all of our experimentation, including that which relates to aviation crash research, has produced this information

regarding the lethal, injurious tolerance limits for man in all different directions.

We begin to have injury along this axis at 60 *G*'s for stopping in a forward-facing direction. If we are seated forward facing and bring the vehicle to an abrupt stop, we can take up to 60 *G*'s with a duration of between one-tenth and half a second, and a rate of buildup of 5,000 *G* per second, provided you have the head locked securely, shoulder straps, lap belt, chest belt, and so forth, arms and legs tied down.

In the backward-facing position, we can go up to 90 *G*'s without injury, and we do not begin to kill until we get to 200 *G*'s, that is, for a subject that is thus restrained.

In the up-and-down axis, which is important because we have people being shot upward out of airplanes in the ejection seat, no injury has been produced in actual human exposures to 33 *G*'s, 500 *G*'s per second, in four one-hundredths of a second.

No injuries have been produced in downward ejections at 16 *G*'s, at 200 *G*'s per second. But if the back is out of position, a man is hunched forward with his back completely flexed in a bow, that bow can be broken by as little as 10 *G*'s, and we had that actually happen, and motion picture cameras trained on an aircraft in an experiment, a Navy aircraft in an experiment where they were developing a new way of landing.

They were landing on a cushion, inflated cushion, 12 feet thick, and about 50 feet long, with snubbing cables, and this gears-up type landing device. The tail hook of the airplane failed to catch on the cable, and the airplane went over the brink of this cushion at 83 knots, tipped over, and hit the ground.

This whipping action of tipping over doubled the test pilot up with his chin practically on his knees, and when he hit the ground he got a broken back. And that only took from 9 to 14 *G*'s as measured by 3 different accelerometers in the cockpit, and we got nice little motion pictures of him getting his back broken.

It is important that the back position be held upright for that type of crash.

Then we are doing a series of tests now of finding tolerance in this posititon, because we came around to much higher forces of getting a man out of an airplane and keeping him alive in supersonic escape. But we are getting pretty clear pictures, as you see in this rather cluttered slide, of how much the human body can stand in terms of brief application of mechanical force.

This is a simple, almost monotonous type of experimentation, but the information is very vital as it applies to our most serious preventive medicine problem in the United States today, and that is the problem of keeping people alive in rapid transit, whether it be in airplanes or ground vehicles.

It has been a privilege to be able to present this information to you, and if there is anything further that I can bring up or give to the committee by way of information, that would be my further pleasure. If you have any questions, I would be delighted to try to answer them.

Mr. ROBERTS. Thank you, Colonel. We greatly appreciate your appearance here. The subcommittee would rather you would go back to

your chair to proceed with the questioning, if you will take the witness chair, Colonel.

Mr. Rogers?

Mr. ROGERS. Not at the present time.

Mr. ROBERTS. Mr. Schenck?

Mr. SCHENCK. No questions.

Mr. ROBERTS. Mr. Friedel?

Mr. FRIEDEL. No questions.

Mr. ROBERTS. Mr. Loser?

Mr. LOSER. Apparently, the subject has been just a bit technical, and we are hesitant to make too many inquiries. I do want to say it seems to me that the colonel and his Air Force have done a magnificent job in making these several tests. I would like to express my appreciation to him for having presented this very enlightening information to us.

Mr. ROBERTS. Thank you, Mr. Loser.

Colonel Stapp, during this session of the Congress, I am sure you are aware of the fact that, at the time of the debate on the defense appropriations bill, something was said by one of the Members with reference to this activity in which you have been engaged, at least I took it that way, that it applied to the crashing of cars, and was one of the arguments used, perhaps, to cut appropriations.

I certainly did not go along with that viewpoint, but I would like for you to give us some of the reasons why the Air Force is doing basic research in automobile crashes, for the record.

Colonel STAPP. All right, sir. First, it is our foremost cause of hospitalization, and our second cause of death, in Air Force personnel. In accordance with the Medical Corps' mission of conserving the fighting strength, it is, therefore, of primary importance that we attack this problem in order to reduce the death, injury loss, and even the monetary loss to the Air Force, because of automobile and ground-vehicle accidents.

Mr. ROBERTS. Do you recall how many members of the Air Force lost their lives in air crashes during 1956?

Colonel STAPP. In the year 1956, slightly more than 700 lost their lives in air crashes, and 673 lost their lives in automobile crashes.

Mr. ROBERTS. I would like to ask you, also, if any of the results of this basic research in the automotive field, in your opinion, carry over to the Air Force work?

Colonel STAPP. That is a mutual carryover. We started out with aircraft crashes, and, by using the same agency, namely, the medical field laboratory of Holloman, to do the car-crash work, we made use of the same equipment that was fabricated for airplane-crash research, and there was no duplication, because it was merely a specialized continuation of airplane-crash research into the car-crash field.

Mr. ROBERTS. About when did you begin your work in this field?

Colonel STAPP. In March of 1947 to June of 1951, I did exclusively airplane-crash research. Then after a 2-year tour of duty at Wright Field, I was transferred to Holloman Air Development Center as chief of the Holloman Air Development Center's air medical field laboratory, and, in the year 1953, I did escape-deceleration research, and in 1954, about April of 1954, we began the work on automobile-crash research.

This has represented utilization of 1 officer part time, and of between 5 and 10 percent of the capability of our laboratory, and with the addition of very little equipment, of minor cost, to apply directly to the automobile-crash research, and utilization of all of the equipment we had set up for airplane research.

Mr. ROBERTS. Could you give us any figures as to the cost per fiscal year of the automobiles that you use in these crash demonstrations, what it costs the Government?

Colonel STAPP. Well, the automobiles are drawn from salvage yards. They are no longer repairable, and you can take the cost sold as junk per pound. I do not know how much scrap iron goes per pound, but that is all that it would cost for the automobiles that we have used. We have not used anything except salvage-yard unrepairable automobiles.

Our monetary cost has been approximately $80,000 for outside contracts. The contract with the University of Minnesota and the contract with the University of California at Los Angeles, stretched out over approximately 4 years, if we will count until June of 1958 it will be 4 years, that is about $20,000 a year, and that amounts to 2 cents per year per person in the Air Force.

Mr. ROBERTS. On this project for the past year, what did your appropriation run?

Colonel STAPP. We had the in-house effort, which was a little difficult to assess. It is just a matter of utilizing the people and equipment that are there. And $10,000 of the $40,000 we have invested in the University of California contract, and approximately $13,000 with the University of Minnesota, it is about $23,000 other than the in-house effort. The people were there; the equipment was there. We went ahead and worked.

Mr. ROBERTS. Can you point to any improvements which have been made by the Air Force with reference to harness or lap belts or improvements in cockpit design that have grown out of these experiments?

Colonel STAPP. Well, first of all, with aircraft, the MATS, Military Air Transport Service, has reverse seats in all passenger transports. The harnesses, crash harnesses, for aircrews, particularly in bombers and fighters, have been designed in the strength requirements to comply with the human limits which we have found in these experiments.

Mr. ROBERTS. Do you recall any actual instances when, as a result of that work, you think lives have been saved or injuries have been lessened?

Colonel STAPP. The Air Force flight safety reports about one-third as many injuries and deaths in the aft-facing transports as occurred previously in corresponding aircraft without the aft-facing seats. That is one item.

Ground safety just placed a bulletin in front of me of accident data. I am a little bit more familiar here with individual cases than I am with statistics. Those can be obtained from Air Force ground safety.

But recently one of my sergeants on leave was involved in a car accident, and more than $600 of damage was done to his car, but no member of his family, including the smallest children, were in any way injured, and they were all held in by lap belts.

Mr. ROBERTS. I noticed from your presentation you refer to this item in which we are interested in these hearings as a lap belt. Do you do that for any particular reason?

Colonel STAPP. Well, that is a good descriptive term, in that it states where the lap impinges on the human anatomy, and——

Mr. ROBERTS. I mean by that, do you make any recommendation as to where the belt would be held about the human body to get the best result?

Colonel STAPP. Yes, sir. A belt should fit into the crease of the hips so that it bears against the prominent pelvic bones on each side, and reduces the force impinging on the soft abdomen between those bones. It would be rather lethal to have a belt around the waist in such a manner that the occupant would push his waist forward against the belt and then slide underneath.

(Discussion off the record.)

Mr. ROBERTS. You may proceed, Colonel.

Colonel STAPP. The lap belt represents an acceptable compromise that gives protection through the range of a large percentage of car crashes. Now, if we could strap a person in the seat that had a headrest, and lock his head, hands, legs down and use shoulder strap, chest strap, the lap belt, tie-down strap, just as we would for an aviator who is being ejected from an airplane at supersonic speed, I feel certain we would give him protection through everything except collapsing the car completely against him, or else burning him up in it.

However, you cannot drive a car that way. I know that people will accept a lap belt, because it is comfortable. It helps to hold you in good position during a long drive. And many people would not accept shoulder straps.

Mr. ROGERS. Will the gentleman yield there?

Mr. ROBERTS. I will be glad to yield.

Mr. ROGERS. Colonel, the lap belt or seat belt serves different purposes in aircraft than in automobiles, do they not?

Colonel STAPP. It has two purposes in aircraft. One is to hold a person in his seat during turbulent flight, when he is thrown around; and the other is to give him some measure, not much, but some measure of crash protection in an airplane crash.

Bear in mind that an airplane crash, it is at 80 miles an hour or higher speed; whereas the largest majority of automobile crashes occur at 40 miles an hour or less. People are able to put on brakes and slow down to 40 miles an hour.

Mr. ROGERS. By reversing the seats, you accomplish more in the safety factor area than you would by providing seat belts with a forward-facing seat, do you not?

Colonel STAPP. Yes, sir. But again, that is a compromise.

Mr. ROGERS. Yes; I understand that.

Colonel STAPP. Yes.

Mr. ROGERS. In other words, the reversing of the seats, plus the safety belt, is an additional safety factor?

Colonel STAPP. Absolutely, and essential in airplanes for passengers.

Mr. ROGERS. Do you advocate the use of seat belts in automobiles?

Colonel STAPP. I do; yes, sir. Definitely.

Mr. ROGERS. I mean, do you do that now as an individual, or as a spokesman for the Air Force?

Colonel STAPP. I have 9,000-pound test lap belts in my car, and I could not afford to be caught dead without one.

Mr. ROGERS. What is the policy of the Air Force on that?

Colonel STAPP. We are conducting a test case at Holloman, that is to say, we are installing lap belts in all of our vehicles, and we are going to use propaganda to persuade as many people as possible on the base to use lap belts.

Mr. ROGERS. Well, now, what I am getting at is this: Do you know of any move at the present time on the part of the Air Force to adopt a policy requiring seat belts in all Air Force automotive equipment?

Colonel STAPP. That has been considered, and I think it is still under consideration, through the Ground Safety Office. My work stops at providing scientific criteria and recommending what is to be done.

Mr. ROGERS. Is yours the only laboratory or work of this kind in the armed services, or do you have in the Army, in the Navy, a group that is doing the same thing?

Colonel STAPP. No, sir. We had coordination with Army, Navy, Marines. We found that a little bit of work was being done in the Army Tank Laboratory at Fort Knox, I believe, it is in Kentucky, but not much.

Mr. ROGERS. But the information that you compile, do you make that available to the Army and the Navy?

Colonel STAPP. Yes, sir; absolutely.

Mr. ROGERS. And they use that?

Colonel STAPP. Yes, sir.

Mr. ROGERS. Now, the information that you are gathering together, insofar as automobile crashes are concerned, is not confined to service equipment, is it? That includes personal equipment of the airmen, does it not?

Colonel STAPP. Well, it is applicable to all types of vehicles, including personal vehicles.

Mr. ROGERS. I see.

Colonel STAPP. That is why this same information is made freely available to the industry and is used by the industry.

Mr. ROGERS. Are you making any studies of the boys who are in the Army or in the Navy who are having automobile crashes, or are you confining yourself merely to airmen?

Colonel STAPP. Well, there is only one model of man, and what we find out about airmen applies equally to Navy and Army, Marines, anybody in the United States, for that matter, insofar as human limits are concerned.

Mr. ROGERS. I see. And that is the theory that is being used?

Colonel STAPP. That universally applicable information is what we gather, and we make it available.

Mr. ROGERS. Thank you very much.

Mr. FRIEDEL. Mr. Chairman, I have some questions.

Mr. ROBERTS. Mr. Friedel.

Mr. FRIEDEL. Colonel Stapp, I notice that you mentioned 3-inch lap belts. Having experimented with the various widths of the strap, do you think there is any difference in the effectiveness of the 2-inch and 3-inch strap?

Colonel STAPP. I would not recommend going to less than 2 inches; and I do not think there is enough difference between 2 and 3 inches, in actual protection, to require more than 2 inches.

But from a comfort standpoint, it is a little easier on my experimental subjects to use a 3-inch lap belt in the first set of tests we have conducted. We plan to do tests through the same range with 2-inch lap belts.

Mr. FRIEDEL. One more question.

Do you recommend how they should be worn, tight or loose?

Colonel STAPP. Yes, sir. They should be worn snugly.

Mr. FRIEDEL. Sir?

Colonel STAPP. They should be snug.

Mr. FRIEDEL. Snug?

Colonel STAPP. Because if you allow a 4-inch or 5-inch loop, the occupant can start forward and be arrested by this belt, and somewhat increase the impact effect, particularly local where he hits the belt.

Furthermore, we are not certain that he would stay in the belt or that it would stay in the crease of the hips.

Mr. FRIEDEL. Thank you, Colonel.

Thank you, Mr. Chairman.

Mr. ROBERTS. Any further questions?

(No response.)

Mr. ROBERTS. Thank you very much, Colonel. We are greatly indebted to you for the presentation you have made, and I think you are making a real contribution in the field of traffic safety and air safety, and I certainly wish you well in the work you are doing in the future.

Colonel STAPP. Thank you, sir.

Mr. ROBERTS. We have also Major Anderson.

If you would like to come around, Major, we will be glad to hear from you.

STATEMENT OF MAJ. GEORGE O. ANDERSON, CHIEF OF ENGINEERING AND RESEARCH DIVISION, ASSISTANT FOR GROUND SAFETY, DEPUTY CHIEF OF STAFF, PERSONNEL, HEADQUARTERS, USAF

Major ANDERSON. Sir, I did not come prepared for a presentation, but I did have something that might be an answer to a question raised a little earlier by Mr. Rogers, if I may hand these out.

I am Maj. George O. Anderson, and I represent the Assistant for Ground Safety, Deputy Chief of Staff, Personnel, Headquarters, USAF.

And, as Colonel Stapp has already indicated, sir, we work very closely with Colonel Stapp's organization, and the Air Research and Development Command, and we are particularly concerned with this area of motor-vehicle accidents. As Colonel Stapp has indicated, it is one of our saddest areas of exposure.

As a result of Colonel Stapp's research in the area of motor-vehicle crash injury, we have taken much of the data established by Colonel Stapp in a report, a technical report, and have included much of that information in this ground accident abstract that you have a copy of. This is a semiofficial piece of Air Force correspondence. It was prepared within my own office, and it was published and distributed Air Force-wide in some 20,000 copies.

Mr. ROBERTS. Would you care to make that available for the record, Major?

Major ANDERSON. I would be pleased to.

Mr. ROBERTS. Without objection, it will be incorporated in the record.

Major ANDERSON. It is Ground Accident Abstract No. 56–16, August 10, 1956, and the subject is "Officer's Life Saved by Seat Belt in Head-On Car Crash."

(The document referred to is as follows:)

[No. 56–16]

HEADQUARTERS USAF,
Washington, D. C., August 10, 1956.

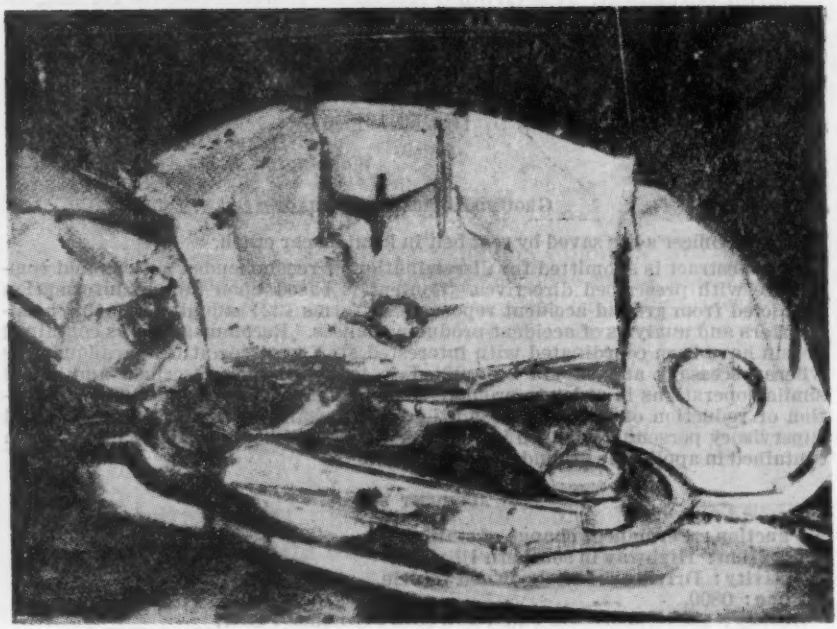
GROUND ACCIDENT ABSTRACT

Subject: Officer's life saved by seat belt in head-on car crash.

This abstract is submitted for dissemination of recommended actions and compliance with prescribed directives. Content is based upon factual information extracted from ground accident reports (AF forms 122) submitted to this headquarters and analysis of accident-producing causes. Recommendations contained herein have been coordinated with interested staff agencies at this headquarters where necessary and should be applied to the operation described and to all similar operations in order to promote efficiency and safety through the elimination or reduction of hazardous conditions and unsafe practices. Operating and supervisory personnel engaged in these activities will be apprised of information contained in applicable ground accident abstracts.

ACCIDENT DATA

Function: Permanent change of station.
Location: Highway in southern Illinois.
Activity: Driving privately owned vehicle.
Time: 0800.
Agency: 1955 Oldsmobile Tudor and 1952 Plymouth 4 door.
Extent of injury: Fractured nose and sternum; multiple lacerations of face and knee; contusion of chest and both knees. Two persons were killed and six injured in the other car.
Property damage: Both privately owned vehicles were demolished.



Front view of vehicle No. 1 after head-on collision (MA23.05.002).

Interior of vehicle No. 1, showing seat belt which minimized injuries to driver (MA23.05.002).

Details of occurrence: A lieutenant was en route to his next assigned Air Force base after spending a leave at his home. The lieutenant had just left the city limits of a small town and was driving north at a speed of approximately 35 miles per hour when a car approached from the opposite direction at a speed of about 60 miles per hour. The oncoming vehicle had just passed another car on a curve, run off the road on the left side for about 150 feet, and then swung abruptly back onto the road directly in the path of the lieutenant's vehicle. The two vehicles struck head on damaging both cars beyond economical repair. The lap-type seat belt which the lieutenant had installed only the day before restrained him sufficiently to prevent fatal injuries. The lieutenant stated, however, that a slightly tighter adjustment of the safety seat belt would probably have prevented even the minor injuries which were incurred. The other car, in which 2 persons were killed and 6 injured, was not equipped with any type restraining device.

ACCIDENT CAUSE

1. The driver of the other vehicle passed in a "no passing" zone.

RECOMMENDED PREVENTIVE ACTION

1. Passing should not be attempted except when authorized and safe to do so.
2. Installation of safety seat belts in all passenger vehicles is encouraged as it will either prevent or reduce the severity of injuries received when accidents do occur. (See attached seat belt standards.)

NOTE.—Installation of safety seat belts will not prevent an accident. Seat belts are designed to restrain persons to prevent them from being thrown out of the vehicle or against the dashboard, windshield, etc., in event of an accident. In addition, seat belts permit more effective control of the vehicle in the event of a blowout or a side-swipe type of accident because they anchor the driver in place behind the wheel. Safe driving habits constantly practiced represent the best and surest method of preventing vehicle accidents.

RECOMMENDED MINIMUM STANDARDS FOR SEAT SAFETY BELTS AND THEIR INSTALLATION

1. Lap-type auto seat belts must be designed and installed to permit restraint of only one person per belt assembly.
2. Belt webbing of nylon or dacron material is preferable provided its breaking strength equals or exceeds 5,000 pounds.
3. Metal parts in the belt assembly should be stressed for 6,000 pounds and must be free of burrs and sharp edges.
4. Closed loop strength of each belt assembly and installation must be at least 5,000 pounds. When opened, either part of the belt assembly and installation must be able to withstand a minimum static load of 2,500 pounds.
5. Fittings, attachments, take-up devices, buckles, and hardware must resist belt slippage and/or failure when subjected to a pull of 2,500 pounds.
6. Belt parts and webbing which come in contact with the body should be not less than 1¾ inches nor more than 4 inches in width. Preferred width is 1¾ to 2 inches.
7. Two suggested acceptable methods of installing seat belts are:
   (*a*) Secure belts to a metal channel bar or pipe which is rigidly secured to the seat frame at rear of seat. This integral unit is then secured to the car frame by cable (10,000-pound aircraft control cable or equal) which is fitted downward through holes drilled in the car floor panel. This method of installation is especially adaptable to front seat-belt installation, and it affords added rigidity to the seat, preventing it from tearing loose in event of collision.
   (*b*) Reinforce floor panel with metal bar and attach belts to floor panel and bar by means of metal washers.
8. Seat belts when properly installed and adjusted to the wearer should apply restraint to the pelvic region in a direction rearward and downward. The belt should be in a line approximately 45° from the horizontal and parallel to the side of the vehicle.
9. Length of the belt should be easily adjustable.
10. The buckle should be foolproof, simple to operate, preferably metal to metal attachment of the two halves of the lap belt, and the lap belt assembly should afford a quick release method.

11. A force not exceeding 45 pounds should release the buckle while a tensile load of 125 pounds remains on the belt after the belt has been subjected to a tensile test load of 1,500 pounds.

12. Seat belts must be adjusted to fit the wearer snugly in order to secure maximum protection in event of accident.

NOTE No. 1.—A seat belt improperly installed or adjusted loosely may be as hazardous as no seat belt at all in event of accident. This is evidenced by a recent fatal accident wherein a passenger, with seat belt adjusted very loosely, was killed when the car struck an oncoming car. Upon impact the passenger slid forward and downward until the safety belt caught him on the throat, severing his trachea.

NOTE No. 2.—The above comprise only minimum standards. Personnel planning to install seat belts in their vehicles are encouraged to be selective in choosing seat belts and buy those with highest standards, thereby affording maximum protection when needed.

(Prepared by Assistant for Ground Safety, Deputy Chief of Staff (Personnel). Headquarters USAF, Washington, D. C.)

Major ANDERSON. We use as an example an actual occurrence within the Air Force, and we have described in particulars here an officer's experience, automotive accident experience, in which he came through the accident with little or no injury, which, in his opinion, was based upon the wearing of a seat belt, and we have his comments pro and con.

In the back part of the accident abstract, we have recommended preventive action. And then—this is on page 2, sir—an additional comment which was based more or less completely on Colonel Stapp's research, recommended minimum standards for seat safety belts and their installation.

We have two problems within the Air Force: First of all, Government vehicles, and accidents sustained in Government vehicles; and secondly, the private motor vehicle owned by the man himself.

Most of our accidents are being sustained in the private motor-vehicle area, over which we have considerably less control, obviously, than we do over the Government vehicle.

So we published this document, as I said, sent it out through official channels, in approximately 20,000 copies. All of the ground safety officers throughout the Air Force received copies of this, as well as other persons in normal distribution.

We provide the material in this form so that they can recognize the problem, they can recognize the cause, and they can recognize what can be done or should be done to eliminate the cause.

Since most of the accidents are in the private motor-vehicle area, there is considerable effort that must be expended toward educating our airmen toward procuring these belts at their own expense and wearing them.

We feel we have accomplished a great deal in this area, but we have no tangible terms as of now in which to completely evaluate those efforts.

We have taken another step within the Department of Defense as a result of the Armed Forces Epidemiological Board's recommendation that seat belts should be included in all Government vehicles. We are presently working with the Department of Defense in trying to establish an Air Force policy with regard to seat belts.

What I am about to say now in no way lessens what Colonel Stapp has already said, but I am sure he will agree that to just arbitrarily say, "You will put a seat belt in every Government vehicle," might be foolhardy in some respects because of the open-type vehicle that Colonel Stapp mentioned, and that sort of thing.

So this policy has not been firmed up as of now, but we are leading our efforts toward that direction.

We are also coordinating with the General Services Administration in the development of a Federal standard and Federal specification which will pool the ideas of many of the gentlemen who are here today, in obtaining a specification which will cover the design and the criteria of seat belts, the configuration of seat belts, and a standard which will cover the actual installation of the belt.

We have two separate and distinct problems which have to be married together.

These two documents are presently in more or less final stages of development. They have been spearheaded by the General Services Administration, however, so I am not at liberty to say just how far along they have progressed.

However, contact with those people about a week and a half ago indicated they are coming along in fine shape.

We have taken this abstract and have sent it to the Army Air Force Exchange Service, and asked that they distribute it within all of their exchanges, with the hope that they will procure only adequately designed seat belts, and will install these seat belts in accordance with accepted procedure.

We have gotten confirmation from them, oh, possibly 6 months ago, and the letter, a copy of the letter that they sent to all of their exchanges, Zone of Interior, United States, and overseas.

We hope through this particular procedure we will further pass on the word of seat belts. We can see a considerable amount of good coming out of it. We have gotten much favorable reply from our safety directors of recent months, and we hope that we can see a definite drop in our accident trend in the future.

I mentioned that we did not have specific factual data from which we can make a comparison. Unfortunately, our accident reporting regulation was such that we could not specifically pinpoint much of the data that we needed.

We have since corrected that by the publication of an amendment to our primary reporting regulation, this change, will bring to us about 20 bits of additional specific information from which we can at a future date make this comparison.

A question was raised, sir, about the traffic safety program within the Air Force. I was not alerted to this, and therefore did not come prepared. This information can be obtained, sir, and we will be pleased to present it at some future date, if it is agreeable.

I have a copy of the regulation, however, if you would care to have that.

Mr. ROBERTS. I would be glad for you to incorporate in the record and present, at some future date on which we can have you come back, the program which the Air Force is following. (See p. 245.)

Major ANDERSON. All right, sir.

Mrs. Henderson mentioned some time ago you were strictly concerned with seat belts, and that is why I was not prepared for that.

Mr. ROBERTS. Thank you very much, Major.

It may be that the other gentlemen have questions. Mr. Loser?

Mr. LOSER. I was just wondering if we could suggest to the Big Three in the automobile industry, and that includes General Motors,

that the 3-inch belt be installed as standard equipment in all of their cars, come next fall.

That would be a very fine thing, would you not say, Major?

Major ANDERSON. I am sure it would be met with open arms by many people.

Mr. ROBERTS. Mr. Schenck?

Mr. SCHENCK. I have no questions at this time, but I think it would be fine to have these hearings continued further at a later time.

Major ANDERSON. Thank you, sir.

Mr. ROBERTS. That concludes the hearing for this morning. There will be hearings on Tuesday, Wednesday, and Thursday on similar subjects, and these hearings will either be continued in this hearing room or at the Banking and Currency hearing room, and proper notice will be given outside the entrance to this hearing room.

If there is nothing further, the subcommittee will stand in recess until Tuesday at 10 o'clock.

(Whereupon, at 11:45 a. m., the subcommittee recessed, to reconvene at 10 a. m. Tuesday, August 6, 1957.)

AUTOMOBILE SEAT BELTS

TUESDAY, AUGUST 6, 1957

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON TRAFFIC SAFETY
OF THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The special subcommittee met at 10 a. m., pursuant to recess, in room 1302, New House Office Building, Hon. Kenneth A. Roberts (chairman of the subcommittee) presiding.

Mr. ROBERTS. The meeting will please come to order. This morning the Subcommittee on Traffic Safety will continue the hearings on the crashworthiness of seat belts. As stated previously, the intention of the subcommittee in holding these hearings is to serve the public interest by hearing qualified witnesses testify in an effort to determine the safety value of automobile seat belts.

During these hearings the subcommittee expects to hear from all members of the automobile industry. This morning, representatives from the Ford Motor Co., the General Motors Corp., and the Chrysler Corp. will testify, and time permitting, we shall also hear from Dr. James L. Goddard, Chief of the Accident Prevention Activities Division of the United States Public Health Service.

Our first witness this morning will be Mr. Alex Haynes, director of engineering for the Ford Motor Co. The subcommittee has had the pleasure of having you testify before the subcommittee previously, Mr. Haynes, and we are again pleased that you are able to be here this morning to testify on this specific topic of seat belts.

STATEMENT OF ALEX L. HAYNES, DIRECTOR, ADVANCED PRODUCT STUDY, FORD MOTOR CO.; ACCOMPANIED BY FLETCHER N. PLATT, MANAGER, TRAFFIC SAFETY AND HIGHWAY IMPROVEMENT DEPARTMENT, FORD MOTOR CO.

Mr. HAYNES. Thank you, Mr. Chairman.

Mr. Chairman, I am Alex Haynes, director, advanced product study of Ford Motor Co., engineering staff. I would also like to introduce Mr. Fletcher Platt, of our highway and traffic safety department.

For the past 5 years I have been responsible for the technical development and testing of Ford products in respect to their safety features. I am also chairman of the Society of Automotive Engineers seat belt committee. I want to thank the subcommittee most sincerely for this opportunity to describe the experience of Ford Motor Co. with regard to seat belts and to explain why we are so confident of their usefulness in decreasing injury on the highways.

I also want to express the appreciation of Mr. Robert S. McNamara, group vice president of Ford Motor Co., who was invited but was unable to join me here today. Mr. McNamara has asked me to express his regret and to read a brief statement on his behalf.

Two years ago, Ford Motor Co. pioneered in the sale of seat belts as factory-installed options. This decision was made after many months of extensive tests and a thorough analysis of data received from actual crashes. Today we have further substantiating evidence. It is our opinion that the use of seat belts in all cars and trucks on the American road today would reduce the 40,000 fatalities annually to less than 19,000 and would reduce the 1 million serious injuries to no more than 500,000.

I would like to assure the committee that Ford Motor Co. intends to continue the promotion of safety through education of the public regarding the use of seat belts and will continue to develop new safety features to reduce accidents and crash injuries.

Mr. Chairman, I realize that this hearing is directed primarily to the question of seat belts, and I would like to restrict my testimony on this particular subject. However, I was present yesterday when reference was made to an article in the New York Times about the diminishing interest of the manufacturers with regard to safety in their 1958 products. I would like to just merely say with as much conviction as I can, Mr. Chairman, that Ford Motor Co. will not relax its efforts in the improvement of safety features and the bringing out of any new features in its 1958 and subsequent models. As Mr. McNamara said, we will continue our efforts, and just as soon as the technology will permit us, as rapidly as we can, we will introduce them into our products.

Mr. ROBERTS. I think that is a very timely comment, and I would like to say that speaking for the subcommittee, I know that your reaction to that statement in the New York Times is greatly appreciated. I think the people of this country will appreciate that fact too. I am very glad to hear you say that.

Mr. HAYNES. You gentlemen may recall that during the subcommittee's visit to Dearborn last year, we discussed the interest of Ford Motor Co. in highway safety and demonstrated the methods which we use in developing a safer product. You witnessed a crash test, 1 of more than 100 that we have made—we should underscore that 100, which have provided us with facts that prove beyond all reasonable doubt that seat belts are effective in reducing injuries and deaths.

Obviously, these tests do not give all the answers, for even the most experienced doctors cannot look at a dummy and say whether a human would survive. However, the test information when integrated with the results of statistical studies by Cornell Medical School and clinical tests of the Aero Medical Laboratory, give definite conclusions.

Two years ago, after exhaustive tests and research Ford Motor Co. made seat belts available in all of its cars and trucks.

Information from medical authorities, as well as engineering facts, has provided conclusive evidence that belts properly installed and worn would reduce the extent of injuries and fatalities in traffic accidents. Over the past 2 years, data has been gathered from numerous sources which further confirms our original evaluation, and has provided a quantitative measurement of the reduction of injuries and fatalities. Despite the attempts of certain people to have us believe that seat belts are dangerous, the facts to the contrary are so overwhelming as to leave no room for legitimate controversy.

I would like to summarize some of these facts:

PROVED IN CRASH TESTS

Ford Motor made two identical tests on the company proving grounds—one with dummies wearing seat belts and one without the belts. Electronic measurement of forces, as well as damage of the two vehicles and dummies indicate a major reduction of force of the driver's chest against the steering wheel when wearing a seat belt.

For example, we ran two types of tests into a barrier, which is a severe type of collision. In fact it is, in our estimation, even more severe than two cars hitting headon at the same speed when it runs into a barrier. First we ran a series of tests at 20 miles an hour into a barrier, one car having a belt, the dummy having a belt, and in the other car the dummy not having a belt. In the first instance we measured the forces on the driver's chest. In the case where the dummy was belted, the force on the driver's chest was 28 *G*'s. In the case where the dummy was not belted, it was 70 *G*'s, indicated a much lower force when the dummy was not belted, which gives you a higher potential for injury. Then we ran a series of tests at 40 miles an hour into the barrier. Again in one case the dummy was belted and in the other case not belted. Where the dummy was belted we measured on the chest 92 *G*'s at 40, and where it was not belted 135 *G*'s, again showing a higher potential when the dummy was not belted.

This reduction of force also applied to the passenger's head against the instrument panel when the dummies were equipped with seat belts. Even in the event of a belt break in high-speed crashes, the impact of the body against forward structure is still greatly reduced.

Here again we ran cars 20 miles an hour into a barrier with the passenger this time belted, and we measured the forces on the head, and we measured where the dummy was belted 22 *G*'s, the vertical component of the head, and in the case where it wasn't belted, 56 *G*'s, again a higher potential of injury when the dummy was not belted. But even more startling in this crash was where the dummy was not belted, and I have pictures here to show you, the dummy's head first struck the header and then it broke the windshield, causing more conditions for injury on his head and face, and then it hit the instrument panel in measuring this higher load factor that I mentioned, so we are convinced, at least from our measurements, that a belted passenger and driver is certainly running a lower risk of injury when he is an occupant in a car.

Then here are some facts concerning this problem on the highways.

PROVED ON THE HIGHWAYS

To further substantiate test evidence, Ford Motor Co. contributed $200,000 to the Cornell Medical College crash injury research program in 1955. These funds were to support expansion of research in actual highway accidents.

Mr. John O. Moore, director of the program, recently made a report to you based on a comparative study of nearly identical accidents in 14 States. Comparing this information on a ratio basis, it has been found that people wearing seat belts had a reduction in the occurrence of any grade of injury by 2½ to 1 over nonusers who were injured in

their cars. There was a reduction of 3½ to 1 in the frequency of dangerous and fatal injuries. Comparing seat-belt users to nonusers thrown out of their cars, the dangerous through fatal injuries were reduced by a ratio of 8 to 1.

PROVED IN AVIATION ACCIDENTS AND TESTS

Several years ago another group at Cornell Medical College evaluated safety belts in light aircraft accidents. In the study of over 1,000 cases, I think the figure was actually 1,039, they found that the human body is quite capable of breaking an approved type belt without evidence of internal injuries, thus allaying any fear that seat belts might be more injurious than protective.

It is our understanding that more recent tests performed by the Aero Medical Field Laboratory show that forces considerably higher than 3,000 pounds can be sustained by human subjects when restrained only by a lap belt.

As Colonel Stapp pointed out yesterday, I think he showed the body can carry 4,800 pounds without any injury. In our measurements of cars running into another car at 45 miles per hour, we never measured over 3,000 pounds.

Mr. ROBERTS. In the case he mentioned yesterday, it developed what?

Mr. HAYNES. 4,800 pounds and 27½ *G*'s.

In brief, although seat belts are not a panacea for all accident injuries, they will materially reduce critical forces imposed on vehicle occupants at any speed, whether the belts remain intact or not.

They will also tend to keep the passenger inside the car where his chance of serious injury is reduced 50 percent. With the addition of other safety features, such as the energy-absorbent steering wheel and padded instrument panel, even greater protection is provided. The seat belt can be installed at reasonable cost in any modern vehicle, and is therefore readily available to occupants of all vehicles on our highways today. Previous testimony has been given regarding the importance of engineering design and installation of belts.

Mr. Chairman, at this point I would like to read an addendum here with reference to the automotive seat belt committee. I am chairman of this committee as I mentioned before. The SAE seat belt committee now has been in operation since late 1954 and it includes representatives of the automobile industry through the individual manufacturers, seat belt and webbing manufacturers, insurance groups, the National Safety Council, motor vehicle administrators, the Aero Medical Field Laboratory, the automotive crash injury research of Cornell Medical College.

This group has been working diligently in preparing an acceptable recommended practice for installing seat belts in automobiles. This has been a tremendous job in my opinion when one considers the many factors which are at play in this problem. Human force tolerance information was necessary along with the structural capacity of automobiles and various types of seat-belt materials and assemblies. All this information had to be correlated. This committee has done its job, knowing full well that any recommendations it may make is subject to change when additional information became available.

As a matter of fact, we have a recommended practice in our present SAE Manual, the 1957 issue, and already we have a revised practice

which I would like to submit to the committee, which will enter into our next manual. This just emphasizes the fact that much is yet to be learned, but that we are on solid ground with the work we have accomplished thus far. I would like at this time to submit a copy of the revised recommended practice for the record, if I may.

Mr. ROBERTS. It looks like a bulky book for the record, Mr. Haynes.

Mr. HAYNES. No; these are many copies in here. These are just a few pages for the recommended practice.

Mr. ROBERTS. If it isn't too much we will put it in the record. I think this may be included. Without objection this document, SAE Recommended Practice for Motor Vehicle Seat Belt Assemblies as revised April 1957, final approval May 24, 1957, will be included in the record.

(The document referred to follows:)

EXCERPT FROM RULES OF SAE TECHNICAL BOARD

(c) Every report approved and issued by the board shall carry the following statement:

"All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or SAE recommended practice, and no commitment to conform to or be guided by any technical report.

"In formulating and approving technical reports, the board and its committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

SAE RECOMMENDED PRACTICE FOR MOTOR VEHICLE SEAT BELT ASSEMBLIES

As revised April 1957; final approval May 24, 1957

SAE standards and recommended practices are subject to frequent change to keep pace with experience and technical advances. Hence, the inclusion of the requirements specified in this recommended practice in State or Federal laws where flexibility of revision is lacking, is discouraged.

1. *Scope.*

1.1 This recommended practice applies to single-occupancy, lap-type seat belt assemblies intended for installation in motor vehicles. It specifies performance requirements and laboratory test procedures for such assemblies.[1]

2. *Webbing.*

2.1 Width: Portions of the belt webbing which may come in contact with the occupant should be not less than 1⅞ inches wide under no load and not less than 1 13/16 inches wide when subjected to the rated minimum test load specified in section 2.2.

2.2 Minimum strength: The rated minimum tensile strength of the webbing should be not less than 2,250 pounds when tested in accordance with section 2.4.

2.3 Elongation: Percent elongation of the webbing should not exceed 25 percent under tensile test load specified in section 2.2.

2.4 Tensile test: Three samples of the webbing should be tested to determine compliance with the width, minimum strength, and elongation requirements given in the preceding sections. The tensile tests should be made on samples which are at equilibrium with an atmosphere having a relative humidity of not more than 67 percent and a temperature of not more than 80° F. The samples should be tested in a suitable testing machine, using grips conforming

[1] Compliance with the requirements of this recommended practice does not provide assurance that, when the seat-belt assembly is installed, the floor-pan washers or other car structure reinforcing plates supplied with the seat belt will be adequately strong to sustain the test load specified in paragraph 3.1 for the belt assembly. Generally, a test of an installation in a car is necessary to determine the adequacy of the reinforcing plates. For recent models, data on tested anchorage installations can be obtained from the vehicle manufacturer.

to USAF Air Material Command drawings MIL–330, 330–1, 330–3, and 330–4. (Copies of these drawings may be obtained from the Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York 17, N. Y.) The samples should be mounted in the machine when the grips are 6 to 10 inches apart. The machine heads should separate at a maximum rate of 4 inches per minute under no load. Before load is applied, the webbing width should be measured, and then remeasured while the minimum strength load is applied. Before load is applied, the webbing should be suitably marked to facilitate measuring the elongation. Each test sample of the webbing should withstand a load at least equal to its rated minimum tensile strength, for at least 3 seconds, without failure.

3. *Belt assembly.*

3.1 Rated minimum strength: The belt assembly, including webbing, buckle, and adjustment and attachment fittings, should withstand a static loop load of not less than 3,000 pounds, when tested in accordance with section 3.4.

3.2 Maximum buckle release force: The belt buckle should release when a releasing force of not more than 45 pounds is applied, when tested in accordance with section 3.5.

3.3 Slippage: Slippage of the webbing in the adjusting means at or near the buckle, in the release mechanism, and at the attachment fittings, should not exceed a total of 1 inch under test load specified in paragraph 3.1.

3.4 Rated minimum strength test: Three belt assemblies, selected at random, should be tested to determine compliance with the rated minimum strength requirement specified in section 3.1. Each belt assembly should be tested in a suitable testing machine or in an appropriate vehicle using the attachment bolts, fittings, and other hardware provided by the seat belt supplier as part of the assembly. The test installation should be made in accordance with the installation instructions furnished by the seat belt supplier. The load should be applied to the belt by a body block having the dimensions shown in figure 1. The body block should be constructed sufficiently stiff so as not to deform significantly under test load and the semicircular surface may be padded with no more than 1 inch of medium density sponge rubber, or equivalent, and covered with suitable fabric to simulate a person's body and clothing. For the test set up, either in the laboratory or in a vehicle, the distance from the top of the body block to the transverse reference line should be 19½ inches to 20½ inches as shown in figure 2 of the appendix, or 13½ inches to 14½ inches as specified in the seventh paragraph of the appendix. The intention is to have the attachment fittings so located and so spaced with respect to the body block as to simulate the conditions when the belt is installed in the vehicle.

Belt assemblies should be mounted for test so that they will be loaded as nearly as practical as they would be stressed when installed in a vehicle in accordance with the belt supplier's instructions. If the belt supplier's instructions describe more than one method of installation, the laboratory in installing the assembly for test should be guided by the method which in its judgment results in the most adverse angular and dimensional relationships authorized by the supplier. (See appendix for discussion of the critical angles and dimensions.) When testing in a vehicle, an angle of 45° will be assumed between the direction of load and horizontal reference. The test report should describe the test mounting of the belt assembly giving pertinent angles and dimensions. At least 10 inches of the free end of the webbing should extend beyond the adjusting means located at or near the buckle. In preparation for the test, care should be taken to lock the cam-type buckle with only the static force of the spring. It must not be jammed down or allowed to snap down. If a metal-to-metal buckle is used it should be checked to determine that there is no danger of latching the two parts together in any manner resulting in reduced strength or holding ability; it should not be possible to obtain partial engagement. Before the load is applied, the webbing should be marked at the unloaded side of each piece of hardware in the belt assembly. After loading belt assembly and releasing load as described in section 3.5, total slippage measurement should be determined from markings and should not exceed amount specified in paragraph 3.3. Load should be applied so as to cause the body block to move at a maximum rate of 4 inches per minute under no load. Each sample tested should develop no less than the rated minimum strength specified in 3.1. At this point, the test may continue for buckle release force as outlined in section 3.5.

3.5 Maximum buckle release force test: Three belt assemblies should be tested to determine compliance with the maximum buckle release force requirement. The belt assemblies used in the rated minimum strength test may

be used for this test. The load applied as recommended in section 3.4 should now be reduced to a loop load of 250 pounds, and while maintaining this reduced load, the buckle release force should be measured. The buckle release force should be applied in a manner and direction typical of that which would be employed by the seat belt occupant. For lever-release buckles, the force may be applied on the center line of the buckle lever or finger tab, one-eighth inch from its edge and in such direction as to produce maximum releasing effect. A three-thirty-second-inch diameter hole may be drilled through the buckle tab or level at this application point, and a small loop of soft wire may be used as the connecting link between the buckle tab or lever and the force-measuring scale. The release force, so measured, should be in conformity with the recommendations in section 3.2.

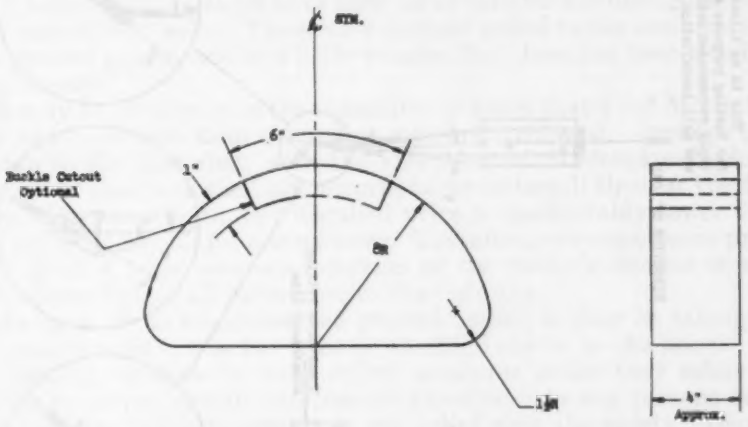
3.6 Abrasion resistance: The belt assembly should have abrasion resistant qualities under normal usage. (The committee is undertaking to develop a test method to evaluate abrasion resistance.)

4. *Metal parts.*

4.1 Burrs and sharp edges: All metal parts should be free from burrs and sharp edges.

4.2 Corrosion test: Mounting hardware exposed to the weather (floor bolts and washers, and so forth) should be subjected to a salt spray (fog) test in accordance with ASTM B117–54T for a period of 50 hours, consisting of 2 periods of 24-hour exposure and 1-hour drying time each. There should be no evidence of excessive corrosion immediately after the above test has been completed, such as would affect the proper functioning of the device.

FIGURE 1—BODY BLOCK



APPENDIX TO SAE RECOMMENDED PRACTICE FOR MOTOR VEHICLE SEAT BELT ASSEMBLIES

This appendix is intended as a guide to aid in establishing the angles to be used in the testing of seat belts so that the laboratory test will simulate, as nearly as practical, actual loading in the vehicle. The lateral spacing of attachment fittings and the angles a, b, and c (appendix, fig. 2) are to be obtained from the seat belt instruction sheet or from the seat belt supplier.

Angle a, indicated in figure 2 as 90°, is the angle the webbing twists between the body block and the attachment fittings. Angles b and c are the angles between the centerline of the webbing and a convenient reference line of each of the attachment fittings, taken in two views normal to each other. Angles a, b, and c represent angles which would result from vehicle installation. For example, angle a can vary from 0° to 90° depending on how the attachment fittings are installed in the vehicle. Angle b is obtained in the vehicle by viewing from the rear, normal to the webbing centerline; angle c is obtained by viewing from the side, normal to the webbing centerline and 90° opposed to angle b. For belts intended for use with adjustable vehicle seats, these angles should be obtained with the seat in its full forward and full down positions. For fitting at-

tachment to structure other than the floor, similar spacing and angle instructions should be used.

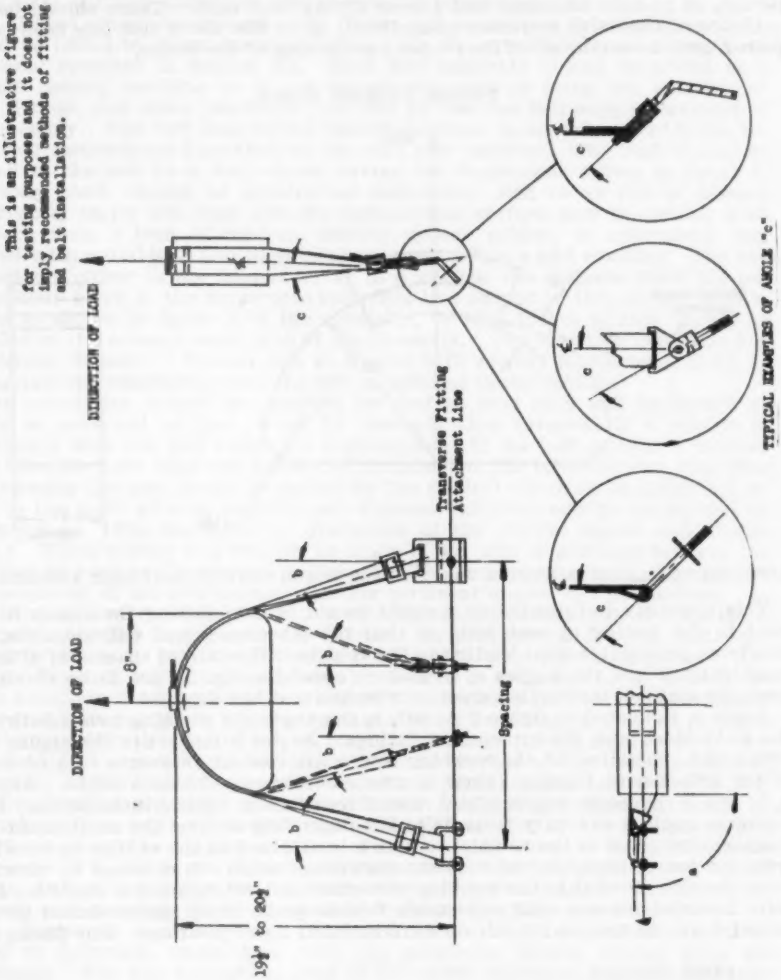
For any seat belt asembly angles a, b, and c should be obtained to the nearest 5° increment, and when less than 5°, these angles may be neglected, if desired.

For any seat belt assembly where more than one spacing is required for installation in different model vehicles it may be necessary to check the different spacings with their corresponding angles a, b, and c, to determine the most adverse condition.

After the attachment fittings are alined with the webbing using angles a, b, and c, the fittings should then be attached to the testing machine, with suitable fixtures, to maintain this alinement under the no-load condition. During loading, this alinement may change due to the stressing or distortion of the fittings.

For the laboratory test setup a 19½-inch to 20½-inch dimension from the top of the body block to the transverse fitting attachment line, figure 2, is to be used when seat belt attachments are mounted directly to the vehicle structure (namely: floor pan, wheel house, doors, etc.).

If the seat belt is intended for attachment to the seat structure and if that structure were originally designed or reinforced to withstand the seat belt loads, a 13½-inch to 14½-inch dimension should then be used from the top of the body block to the transverse fitting attachment line.


This is an illustrative figure for testing purposes and it does not imply recommended methods of fitting and belt installation.
DIRECTION OF LOAD
Transverse Fitting Attachment Line
TYPICAL SAMPLES OF ANGLE "c"
DIRECTION OF LOAD
8"
Spacing
19½" to 20½"

APPENDIX—FIGURE 2—TYPICAL TEST ARRANGEMENT

Mr. HAYNES. Thank you, Mr. Chairman.

The problem today is how to encourage the public to purchase and use seat belts. To some degree, we can evaluate our success in gaining public acceptance of seat belts by examining Ford Motor Co. sales. We announced the introduction of seat belts as dealer-installed accessories on July 12,1955, and since the introduction of our 1956 models, belts have been available on all Ford Motor Co. cars and trucks as factory-installed optional equipment.

Since the 1956 introduction, 160,000 vehicles were purchased with seat belts installed at the factory. In addition over 200,000 belts have been furnished to dealers for their installation.

While our sales figures are considerably higher than originally anticipated, we are disturbed that the rate of seat belt installation has fallen off in the last few months. Of course, this is due to a reduction in dealer orders for belts, which in turn reflects a decrease in public demand.

It has been disappointing to us that the acceptance of seat belts by many groups interested in highway safety has been slow, and, as you well know, there has been a small vocal minority who have generally opposed seat belts on the basis of misinterpretation of data from a relatively small number of accidents and tests.

In recent months, there have been many articles discussing the pros and cons of seat belts. These have further added to the confusion of the general public, and it is little wonder that there has been a reduction in sales.

It may be of interest to the committee to know that Ford Motor Co. has sold more belts than the rest of industry combined. Perhaps this is due to the fact that, with the exception of Studebaker-Packard Corp., we have been the only manufacturer to install them at the factory. For this reason, our installed price is considerably lower than the prices of our major competitors. Therefore, our experience probably gives a more accurate reflection of the public's interest in seat belts than the overall experience of the industry.

As most of us recognize, the general public is slow in taking an interest in safety, whether it be on the highway or in the home. Individually, we seem to resist safety measures unless they relate directly to a very recent unfortunate experience to our persons or to our wallets. Nevertheless, it is my belief that the safety program pioneered by Ford Motor Co. in 1955 is having an effect on the public far more than we have realized to date. We hope that our efforts will be further justified in the future. Our engineering and research staffs are continuing their efforts in the development of safer vehicles, and we are continuing to study means of further improving restraining devices and their installation.

Your committee is to be commended for your contribution to the field of traffic safety. These special hearings on seat belts are most valuable in bringing together the people who are experienced in seat belt development and can do much to clarify the problem for the general public.

In conclusion, I would like to repeat that Ford Motor Co. strongly recommends the use of seat belts in all cars and trucks. In our opinion, tests and experience have proved beyond all reasonable doubt that seat belts are the most effective single equipment item available in reducing traffic injuries and deaths.

Thank you, Mr. Chairman. I hope I can answer any question that you may have.

Mr. ROBERTS. Thank you, Mr. Haynes, for your statement and your appearance here. I would like to ask you 1 or 2 brief questions, particularly in your capacity as chairman of the Society of Automotive Engineers' seat-belt committee. It has been my observation that there are a good many various brands and types of seat belts on the market today. Just from a cursory examination of some of the belts that I have seen, I would not believe that they would do the job, and I am sure, too, that you are familiar with a proposition that, generally speaking, the industry recommends that they be attached to the frame of the car instead of simply to the seat itself or to a part of the seat. To eliminate some of that confusion, I have introduced a bill which would require the seat belt to be tested and approved by the National Bureau of Standards. I am not at all sure that that would put your committee out of business, but I am wondering if you feel that you will get more uniformity through the Bureau of Standards than you would perhaps through this voluntary method?

Mr. HAYNES. How would the Bureau of Standards enforce this?

Mr. ROBERTS. The bill would provide that no seat belt could be delivered or introduced in interstate commerce without first having been approved by the National Bureau of Standards.

Mr. HAYNES. I think the point I made at this time, Mr. Chairman, that it seems to me the industry is most familiar with the local condition as to how the belt should be installed in the automobile. First of all, you have different designs. We as Ford probably have a slightly different situation than, let us say, General Motors, and I think that our committee at the SAE at this point are probably more qualified in determining the recommended practice that could serve the industry at this time.

Mr. ROBERTS. I am not doubting but that the Society of Automotive Engineers could do better, but what I am trying to do is protect the public against the manufacturer who does not put out a standard quality product. It occurs to me that, unless you have some minimum standards, you are going to continue to get these people who are taking advantage of the situation by putting out a product that will not do the job when it is called on to do it, and then the whole case for seat belts goes out the window with one accident where the belt doesn't hold or where it doesn't do what we think it will do and what perhaps other witnesses before this committee think it will do.

Mr. SCHENCK. Will you yield for a question on that?

Mr. ROBERTS. I'll be glad to.

Mr. SCHENCK. Would you feel, as long as seat belts or lap belts put out by various manufacturers meet the criteria of safety as set up by the Bureau of Standards, that that would do the job and that there would therefore be no interference in the free exercise of free enterprise in developing these seat belts, so long as they meet certain criteria of safety standards? Is that what you had in mind?

Mr. ROBERTS. That's what I had in mind in my bill.

Mr. HAYNES. Mr. Chairman, I think actually you have two problems there. You have first the problem of the belt assembly itself. It must meet certain minimum specifications that are outlined as a matter of fact in this recommended practice, but in addition there is another problem of the actual installation in the automobile, and

there it becomes an individual responsibility of the manufacturer. Unless you have the proper installation, I don't care what the belt is in itself, you don't have really the proper specification. Of course, no matter how good the installation if the belt is no good, the same situation exists.

Mr. ROBERTS. I agree, but I don't see any way you can control the installation by legislation. I think you could reach the request of standards by legislation, but I don't think you could tell an individual car owner how he must install his seat belt.

Mr. FRIEDEL. Isn't the buckle a very important part of the safety strap?

Mr. HAYNES. That is part of the seat belt, yes.

Mr. FRIEDEL. Often the seat belt might be strong enough but the buckle might be of inferior quality and not be able to stand the stress in an emergency.

Mr. HAYNES. Right. Therefore, we have to have a recommended practice of the equivalent of a standard as far as the seat belt assembly itself is concerned before it is installed in the car. Then you have to have the proper installation.

Mr. ROBERTS. Now one more question. On page 5 you state, "We have been the only manufacturer to install them at the factory." With that factory-type installation, it occurs to me that you would get much more uniformity than you would in having the belts installed at various garages and dealers' places over the country. Of course, you would only get the opportunity to install these in case you had a factory order; that is, a request in advance that they be installed before the car is shipped to the dealer.

That's correct, isn't it?

Mr. HAYNES. That's right.

Mr. ROBERTS. Could you give us any idea of about what your cost runs on that installation?

Mr. HAYNES. I think we have some figures here.

Mr. ROBERTS. I'm talking about the cost to the customer.

Mr. HAYNES. Yes; I also think we have some such figures. If the customer would get a factory-installed assembly, it would cost him roughly about $13 for 2 belts in a Ford car.

Mr. ROBERTS. How much?

Mr. HAYNES. $13 for a front seat.

Mr. ROBERTS. Two belts?

Mr. HAYNES. Yes, two belts. If he got a dealer's installation it would run roughly over $25, closer to $30 in a Ford car. That is the difference and that is why we feel that probably factory installed is the way to try to market this.

Mr. ROBERTS. Is there any way, Mr. Haynes, that you think it might be practical in the process of manufacturing a car to provide attachment points in the car, that is so that if a customer ultimately makes up his mind to put in seat belts, that he has a car that is already equipped to take those belts at the proper points.

Mr. HAYNES. Of course, I would hesitate to answer the problem from affirmative standpoint; however, we are studying this problem. There are many complications. I mean the costs would still be there.

It would be simpler for the customer I think at this stage as I see the problem, it would be actually a more expensive installation if you

have to first make special fittings to go along with the car whether it has a belt or not. Then you would have to have a special fitting on the end of the belt assembly and this would be a very special fitting to be able to just snap on, let us say, to this fitting that we have provided originally.

We are looking at this problem but we haven't got it solved yet.

Mr. ROBERTS. I believe that is all I have.

Mr. Schenck?

Mr. SCHENCK. Mr. Chairman, following your line of thought on this matter of the Bureau of Standards; as I understand the problem, the Bureau of Standards would set up certain criteria such as, for example, they did in the development of interior releases on refrigerator doors. Then each manufacturer would make his own equipment so long as it met the basic requirements of this method of releasing a refrigerator door.

Is that what you had in mind, Mr. Chairman?

Mr. HAYNES. That is exactly what I have in mind.

Mr. SCHENCK. Mr. Haynes, would that interfere with the development of further criteria by the SAE or by your company?

Mr. HAYNES. I can't say that it would interfere.

Mr. SCHENCK. So long, for example, as the Bureau of Standards required certain strength for a buckle assembly or for the webbing or for the piece of equipment that is to be fastened onto the car, so long as all these parts are required to meet certain approved criteria of this kind, that such would not interfere with your free development.

Mr. HAYNES. Probably not. I honestly can't see why that should interfere. As a matter of fact in this SAE recommended practice, we frankly did not know enough about the problem when we first got started. We adopted the CAA requirements of 3,000 pounds. As a matter of fact I think it was less, 2,750 at that point, and we have since made enough changes and now we have our own which probably so far as comparing it with CAA requirements for aircraft, we think this suits our conditions better. I can't see a minimum standard on a seat-belt assembly, how that would interfere with our work in the SAE committee at this point.

Mr. SCHENCK. Would you think that legislation such as proposed by Chairman Roberts would assist in the general, overall proper quality in the manufacture of seat-belt assemblies as an accessory by a company not connected with a specific manufacturer of automobiles?

Mr. HAYNES. I think it would, although as I pointed out, the companies who are in the business of manufacturing seat belt assemblies are represented on the SAE committee, and assuming that it is a responsible company, I have no question that they would meet minimum recommended practice of SAE. Certainly I think the Bureau of Standards would help wash out let's say more of the fringe companies, these fly-by-night outfits. I would go along with that.

Mr. SCHENCK. It is my understanding that in the case of airplane seat belts, that they must be approved by the Civil Aeronautics Administration.

Mr. HAYNES. That's right.

Mr. SCHENCK. Which perhaps has also established those specifications in connection with the Bureau of Standards' background of information. Have you any particular information, Mr. Haynes, as to the width of a seat belt?

Mr. HAYNES. We are recommending a 2-inch width. Those are the kind of seat belts we install in our cars. I noticed yesterday Colonel Stapp referred to a 3-inch for his tests but he also qualified and said that he could not see a great deal of difference as far as any injuries are concerned between a 2-inch and a 3-inch. In our opinion a 2-inch certainly is more desirable at this stage. I think the customer is more likely to use a 2-inch rather than a 3-inch, and it is important that we first teach the customer to use the belt.

Mr. SCHENCK. As I understood Colonel Stapp's testimony yesterday the 3-inch belts were used because he thought it was a little bit more comfortable personally.

Mr. HAYNES. I would disagree with him on that point. I think it is more comfortable for the people who are taking repeated tests, but I think to wear it let's say on a summer day, I would prefer a 2-inch, and I think it will do the job just as well as the 3-inch.

Mr. SCHENCK. Thank you very much, Mr. Haynes. I appreciate your testimony and the opportunity of renewing our acquaintance.

Mr. HAYNES. Thank you.

Mr. ROBERTS. Mr. Rogers?

Mr. ROGERS. Mr. Haynes, have you undergone any change in your advertising policy in regard to safety?

Mr. HAYNES. I don't think so, Mr. Rogers. I think we talk about advertising, and I am certainly out of my field to answer such a question, but I will attempt it. I think there are certain techniques in advertising. First of all, there is a type of advertising that is to sell a product, and when you first introduce the product, certainly you will do a lot more advertising than after it has been out for a while when the novelty has been worn off.

On the other hand, there is another type of advertising which we have continued as far as the safety and seat belt picture is concerned which we call institutional advertising, and I don't know, there have been millions of these copies and they are still being distributed, a report to the public on safety. This week's Life magazine has a two-page ad on safety. Here an ad, and again a two-page spread, another type for dealers which appeared in the Automotive News here last week targeting to the dealers to sell safety to the public.

I don't think we have relaxed at all as far as advertising is concerned. We have spent millions on advertising programs throughout the year. Mr. Fletcher Platt can talk more about that than I can. We have a series of movies. No, we haven't relinquished one bit in that field in my opinion.

Mr. ROGERS. I was interested because as you will recall, we went into that at the hearings in Dearborn. How long ago has that been?

Mr. HAYNES. Last year.

Mr. ROGERS. Last September. So many things happen here you can't keep up with everything.

Mr. Haynes, there are 1 or 2 other questions I want to ask you about seat belts. You estimated a cost of $13. That is factory installed.

Mr. HAYNES. Yes.

Mr. ROGERS. Does that include four seat belts?

Mr. HAYNES. No, that is two, for the front seat.

Mr. ROGERS. Two for the front seat?

Mr. HAYNES. That's right.

Mr. ROGERS. What are you going to do with the back seat?

Mr. HAYNES. That will have to be extra.

Mr. ROGERS. That would be $13 more?

Mr. HAYNES. No. These are not installed in the factory, Mr. Rogers, in the rear seat. If you are asking for rear seat, we don't have any factory installations. Those are dealer installed. Again we will only install what we think will be sold more at this particular time.

Mr. ROGERS. Don't you think though that they are just as necessary for the back seat as they are for the front?

Mr. HAYNES. Of course, they are, but let's first sell the front seat.

I think more people will be ready to buy the front seat before they will buy the rear seat.

Mr. ROGERS. The thing that is in my mind, the reason I asked the question about the four is that you have these several ratios you put into your statement as to the reduction in accidents. Now were all those front-seat accidents or front-seat injuries?

Mr. HAYNES. No, they could not have been all front-seat injuries. However, I think—and I don't have these figures in front of me—I think you will find that something in the order of—I'll guess, I'll bet over 80 percent of your occupants are in your front seat in the American cars today. Don't hold me to that figure. That is why we feel that it is more important at this time to take care of the front seat.

If you will solve this problem first, then you will certainly be doing a heck of a lot toward the main problem.

Mr. ROGERS. Mr. Haynes, you would advocate though insofar as safety is concerned that the back seat have belts, too?

Mr. HAYNES. Absolutely. I have rear-seat installations in my car.

Mr. ROGERS. Do you advocate, Mr. Haynes, any type of legislation requiring seat belts to be put into cars?

Mr. HAYNES. Mr. Rogers, I think we have a problem of education and I think you are better versed than I am as to how you can best get the public ready about using a particular item. Sure you may legislate say the requirements of the manufacturer to install seat belts in the car, but what good is it if the public is not going to use it? In fact I think if you forced the public to buy a car installed with seat belts and if he isn't ready to really use it, he might have a certain amount of resentment. I don't know, I think first let's do a job of educating the public to use it and I think you might do it better by education and voluntary methods rather than forcing him by legislation.

Mr. ROGERS. What I am talking about is this. There are a lot of people in this country that feel that a lot of gadgets are put on automobiles just to sell the gadget and that may be true. I don't know whether it is or not. But we do know that lots of automobiles are sold minus certain safety devices or devices that we refer to as safety devices such as flashlights and things of that kind. Now the thing I want to know is whether or not the automobile industry is advocating or prepared to advocate legislation that would require certain safety devices to be placed on motor vehicles before they are turned over to the public.

Mr. HAYNES. I don't know that the industry is prepared. I mean I can't answer that question at this time. I don't think it is a matter

of policy. I don't know that the industry has really thought about it where it is ready to make a definite statement. I feel personally that we must first educate the public to want to use the seat belt. I don't know that you can do it by legislation right now.

Mr. ROGERS. Let me ask you this. What is the profit on a $13 item for a seat belt?

Mr. HAYNES. The profit?

Mr. ROGERS. Yes, insofar as the automobile company is concerned. Have you broken that down on a cost-profit basis?

Mr. HAYNES. I don't have the figures here on profit but I will just hazard a guess. We haven't made very much at $13. We haven't made much profit if any. I don't have these figures with me.

Mr. ROGERS. But there is a profit involved in the thing, I'm sure, and there should be.

Mr. HAYNES. I am not sure about this particular one. I think we were really so anxious to get the public to educate it to the idea of seat belts that I am not sure that we have made a profit as far as the seat belt.

Mr. ROGERS. What kind of material are the seat belts made of?

Mr. HAYNES. Well, there is a webbing material. There is a webbing material. There are various kinds. Nylon for one. That is the kind we install in our cars that have to carry a certain strength capacity. For Ford Motor Co. we call for 4,000 pounds loop strength, that is the seat belt placed in a fixture where it is pulled with 4,000 pounds before it will break.

Mr. ROGERS. Where does that material come from? Who manufactures those belts?

Mr. HAYNES. There are many companies that manufacture belts, like the Autocrat Co., that is an outfit that supplies us, Brownline.

Mr. ROGERS. They are a company that makes the belts and sells them to you. Ford Motor doesn't make the belts.

Mr. HAYNES. No; we don't make the belts ourselves.

Mr. ROGERS. Is that company owned by Ford in whole or in part?

Mr. HAYNES. No, sir.

Mr. ROGERS. One thing I am thinking about, Mr. Haynes, is this: Have you tried cotton webbing?

Mr. HAYNES. Yes; there is cotton. We have cotton.

Mr. ROGERS. You know we have got a great surplus of cotton.

Mr. HAYNES. We use cotton belt, too. We are installing those, too.

Mr. ROGERS. They are rather successful. I mean you can treat cotton where it is almost as strong as nylon.

Mr. HAYNES. Sure; that's right.

Mr. ROGERS. I believe that is all at present, Mr. Chairman. Thank you, Mr. Haynes.

Mr. ROBERTS. Mr. Friedel?

Mr. FRIEDEL. Mr. Haynes, I'm sorry that I was a little late and did not hear the first part of your statement but what I did here was very interesting. In your studies of the safety factor of seat belts, have you made any distinction between convertible automobiles and cars that have the hard top or the sedans?

Mr. HAYNES. Of course, we have taken to gross figures as far as the statistics are concerned as supplied by Cornell.

We recommend installation of seat belts in convertibles as well as hard tops.

Mr. FRIEDEL. Do the figures show that seat belts are a safety factor in convertibles where they roll over?

Mr. HAYNES. Yes. However, let me put it to you this way, Mr. Friedel. The rollover increment, the rollover index in cars as a whole is here only 16 percent of the whole problem. Even if you would wash out that 16 percent, you have still got to deal with 84 percent, and I still think in 84 percent of the cases you are much safer in a convertible if it doesn't roll because you may be thrown out, say, onto the street and run over by another car. I think you are better off to have seat belts in a convertible, rollover or no rollover. I have also seen crashes where the top, the roof of the car has been compressed down to the belt line, to the door line, and, because the occupants had seat belts, they came through with no fatalities—in fact, in one case, with a very minor injury. That is because, I think, as you are rolling you are thrown laterally against the seat and you are still more protected than if you took the chance of being thrown from the car. I think the statistics will still hold that you are better off with seat belts in a convertible than without the seat belt.

Mr. FRIEDEL. I want to say this. Our chairman said that he drives a General Motors product and he has seat belts.

Mr. HAYNES. He said Ford seat belt.

Mr. FRIEDEL. O. K. Ford seat belts. Well, I am driving a Chrysler product and I have seat belts in my front seats, and it is not only that I feel safe and secure; I feel relaxed with a seat belt.

Mr. HAYNES. That's right; I think that is a very good point, Mr. Friedel. I think there have been some studies made, I think by Du Pont, that actually show a great reduction in fatigue when you use the seat belt as against not using it. I think that would certainly be a factor in reducing the causation of accidents.

Mr. FRIEDEL. I find it very nice, and I feel safer with them than without them. That is about all, Mr. Chairman.

Mr. ROBERTS. Thank you, Mr. Haynes.

Mr. HAYNES. Thank you, Mr. Chairman.

Mr. ROBERTS. The next witness is Charles A. Chayne, vice president of engineering, General Motors Corp. We are delighted to have you with us, Mr. Chayne. We are renewing our contact today; we appreciate having been guests of General Motors, Ford, and Chrysler at Detroit. The subcommittee certainly appreciated the opportunity of seeing the automotive industry in and around Detroit, and we are deighted to have you here as a witness today. You may proceed with your testimony.

STATEMENT OF CHARLES A. CHAYNE, VICE PRESIDENT OF ENGINEERING, GENERAL MOTORS CORP.

Mr. CHAYNE. Thank you, sir. My name is Charles A. Chayne. I am vice president in charge of the engineering staff, General Motors Corp. I would like to express my personal pleasure in reappearing before you in behalf of General Motors. Since your visit with us last year, we have been following your progress with intense interest—and I would like to underline the word progress.

During our earlier meeting, I believe we all agreed that traffic safety involves many intricate, baffling, ubiquitous, and, I might say, ex-

asperating problems. But, certainly, they are not hopeless, and there is no reason to feel helpless in the face of them.

Today I am here at your invitation to discuss seat belts. This is a subject in which General Motors is vitally interested. In recent years we have actively studied seat belts, shoulder harnesses, and other types of restraining devices for automobiles as a means of protecting the occupants in event of accident.

Our first public showing of a seat-belt installation was in 1951 in one of our experimental show cars. During the next few years, engineers on my staff accumulated many miles of driving experiences with various designs of seat belts, shoulder harnesses, and other types of restraining devices for automobiles as a means of protecting the occupants in event of accident.

Following this, we began to broaden our data on user reaction to belts and harnesses by circulating a test car equipped with various combinations to both engineering and nonengineering personnel on our central staffs and in our five car divisions. We requested that they have their wives and other members of their families drive and ride with these restraining devices in use and report on the reactions and comments. The wider survey confirmed earlier opinions of engineering staff personnel to the effect that public acceptance and demand might be extremely small.

Nevertheless, as is customary with equipment in many categories, especially those concerning safety, we continued our engineering tests to gain more knowledge. This led to our making some very early barrier-crash test for which we used Air Force-type dummies as passengers.

When you gentlemen visited our General Motors proving ground at Milford, you saw an actual barrier-crash test. You also had an opportunity to inspect and see in action the snubbing apparatus our engineers designed and built to enable better comparative tests of various types of restraining devices at predetermined crash-deceleration rates. These tests provide a dynamic method for evaluating the adequacy of anchorages and body structures, supplementing the information obtained from static loading tests made in our laboratories.

With all our accumulated road mileage using belts and harnesses, we had no accident experience. However, the experience gained through our barrier crash, snubbing tests, and other studies showed that under many accident conditions occupants would benefit if suitably restrained.

Engineers in our Fisher Body and five car divisions engaged in an intensive program of testing seat-belt designs and anchoring arrangements to make seat belts available starting with the production of our 1956 models.

At about this time the Society of Automotive Engineers seat-belt committee was organized to develop a recommended practice for seat-belt assemblies and attaching parts. This activity followed the pattern which has been employed successfully for many years in our industry in the cooperative development of automotive standards.

Notable among such efforts in the safety field have been the standards established for lighting equipment and brake fluids. Our own engineers participated in the work of this committee from its begin-

ning, and the free interchange of information resulted in the recommended practice submitted to the SAE technical board and approved on November 14, 1955.

The specification for General Motors seat belts equal or exceed the recommended practice.

Next, concerning the crashworthiness of seat belts—the subject of this meeting—we do not know, as I previously stated, that seat belts of qualified design, suitably anchored and properly worn, have some safety advantages. In view of this, we make seat belts available to our customers.

A precise appraisal of these safety advantages will have to come from the type of data now being supplied to the Cornell automotive crash injury research project by many State and local agencies. Unfortunately real problems are involved in the analysis and interpretation of these data.

In this connection it is interesting to note that the most recent Cornell report indicates that from an analysis of some 10,000 accidents there were only 81 pairs of matched accident cases from which to draw conclusions concerning the crashworthiness of seat belts.

We are very much interested in the progress reports issued by the Cornell group from time to time in connection with its crash injury study. As the collection of data increases, and as the techniques continue to improve, I believe much constructive information will be forthcoming which will be helpful to all of us in appraising the real value of seat belts.

As you might assume, through the years of making rollover and other types of crash tests with our automobiles we have obtained considerable information and data. From our barrier crash tests and snubber testing experiments with anthropometric dummies we have learned much about the order of the forces applied to dummies.

However, we in the automotive industry are not in a position to determine accurately what effect forces in actual traffic accidents have on live human occupants.

We hope that Colonel Stapp's further work will contribute much useful information along this line. We have great respect for his studies on the effect of high rates of deceleration on the human body.

To assist him in his further efforts to learn about the tolerable force limits on belted occupants now in automobile crashes, I have arranged to give him our snubber testing equipment for his continued use. We, of course, will continue our work with duplicate equipment.

This statement summarizes the information and conclusions of General Motors regarding seat belts as of today. I will be glad to try to answer any questions you care to ask. Thank you, Mr. Roberts, for having invited me to this meeting of your committee.

Mr. ROBERTS. Thank you, Mr. Chayne. The committee appreciates your presence here and your statement. I would like to ask you if you have any provision for factory installation of seat belts on General Motors products?

Mr. CHAYNE. No; we do not. Our seat belts are installed by the dealers. That situation is largely a matter of commercial decision. It has been our practice over many years to have most of our accessories of that nature installed in the field by the dealers. I think you will find that that condition will vary depending on the manufacturing

organization that the individual companies have. Of course, we have for many years had assembly plants spread around the country, and with that sort of a setup it is perhaps more difficult to make factory installation of certain accessories than it is if you are more centralized.

Mr. ROBERTS. You were present when I asked Mr. Haynes a question as to providing contact points or attachment points for seat belts, a few moments ago. Do you feel that there would be added any considerable sum to the cost of the automobile if provision were made in the product with a view to placing seat belts in the car at a later date?

Mr. CHAYNE. It would certainly add to the cost of the car. How much I would rather hesitate to make a guess at the moment, but since it does add to the cost, you are faced with the fact of compelling everyone to pay the added cost for the percentage that will use seat belts.

Mr. ROBERTS. Do you think that the encouragement that you might give the general public would be worth that additional cost?

Mr. CHAYNE. Speaking as an engineer and not as a representative of the sales department, on the basis of the evidence that we have of public interest in seat belts, I would say at this time it might not be.

Mr. ROBERTS. That's all I have.

Mr. Schenck.

Mr. SCHENCK. Mr. Chayne, I see again we renew our acquaintance and I certainly appreciate your statement. Does the General Motors Corp. conduct a campaign of advertising the safety of lap belts and of urging their installation?

Mr. CHAYNE. We have called attention to seat belts in our advertising. I couldn't tell you offhand just to what degree it has been carried through, but I know I have seen many ads with seat belts referred to specifically in one of these little notes in the corner. And, of course, all of the material that has been supplied to the dealers with the seat-belt packages has been of a nature to encourage their sale, because, after all, the dealer is an independent businessman and what he tries to sell is going to depend to a great extent on his analysis of the customer demand.

Mr. SCHENCK. Do you supply, Mr. Chayne, the dealer with a package seat belt for installation?

Mr. CHAYNE. Oh, yes.

Mr. SCHENCK. And that is one that is either manufactured by you or under your direction as to its physical requirements?

Mr. CHAYNE. Oh, yes. That is specified—released and specified—by the individual engineering departments of our divisions and is packaged and merchandised through the distribution channels of each division.

Mr. SCHENCK. Are these package seat belts then supplied with detailed instructions as to how they should be installed in order to reach the greatest maximum of safety in your cars?

Mr. CHAYNE. Yes.

Mr. SCHENCK. Mr. Chairman, I think that is all, and I would like to make just this further personal explanation. I find myself in a very difficult position this morning in serving on two very important subcommittees of Congress which are meeting at the same time, the Committee on Health and Science which is meeting with a panel of doctors on food additives, which in itself is a safety measure, too, and

I have to sort of go between the two committees. I'm sorry I can't remain.

Mr. ROBERTS. I assure the gentleman we will not take advantage of the Republican position in his absence.

Mr. FRIEDEL. Mr. Chayne, I am very glad to see you again.

Mr. CHAYNE. Thank you, sir, I am happy to see you.

Mr. FRIEDEL. In reference to Mr. Schenck's remarks, are your seat belts connected to the frame of the body?

Mr. CHAYNE. They are connected to the structure of the body; yes, sir.

Mr. FRIEDEL. They are. Now getting away from seat belts for a second, are you installing the known safety devices on all General Motors products—for instance—the directional signal?

Mr. CHAYNE. Yes. It may not be priced as part of the car assembly. It may be priced as an extra, but we are building our cars with direction signals.

Mr. FRIEDEL. On all cars?

Mr. CHAYNE. To the best of my knowledge; yes, sir.

Mr. FRIEDEL. That is standard equipment?

Mr. CHAYNE. It is built on all cars. It may not be priced as standard equipment. That would depend on the competitive situation, of course, but actually they are required in so many States and you very frequently have no control over where a specific car may go, that we are putting them on all cars.

Mr. FRIEDEL. I am glad to hear that because I know that as late as 1956 models it was not standard equipment.

Mr. CHAYNE. I think on the specifications you may not find it listed as standard equipment, but you will find it on the cars.

Mr. FRIEDEL. Let me put it this way then. I know we have a lot of taxicabs in Baltimore City, and a lot of these taxicabs do not have directional signals.

Mr. CHAYNE. Aren't they required by the State of Maryland?

Mr. FRIEDEL. No, sir, they are not required by the State of Maryland.

Mr. CHAYNE. I see.

Mr. FRIEDEL. And naturally when they buy a cab they try to buy it as skimpy—that probably is not the proper word—but down to a shell of the least equipment they can have. I have always stated that the industry has been a little lax in making the fine safety devices standard equipment. Now could this taxicab company buy a product of General Motors without directional signals?

Mr. CHAYNE. It might be on a group buy, a fleet buy, that they might battle down to a skinned-down automobile and obtain them. I couldn't say offhand, but I know as far as our passenger car sales are concerned, that the direction signals are put on the cars even though they may not be listed in the standard price.

Mr. FRIEDEL. It has been proven beyond a doubt that directional signals are a real safety device, and I think they should be on all cars, whether it is fleet orders or whatever it is, they should have to have directional signals. And there are other safety devices. You wouldn't sell an automobile without a windshield wiper?

Mr. CHAYNE. That's right.

Mr. FRIEDEL. Are you considering in your standard equipment at extra cost, dual headlights in the 1958 model or is that going to be optional?

Mr. CHAYNE. I am not in a position to discuss any of the features of our 1958 automobiles. I have got five car division general managers with whom I have to live and they claim the privilege of announcing their new features. But may I say we first showed dual head lamps on our motorama shows some years ago so from that I will let you draw your own conclusions.

Mr. FRIEDEL. Are dual headlights accepted by the industry as a safety device?

Mr. CHAYNE. We feel that it has been a marked step forward in road lighting; yes, sir.

Mr. FRIEDEL. That is all.

Mr. ROBERTS. Mr. Rogers?

Mr. ROGERS. Mr. Chayne, do you equip your cars when you build them with the facilities to put the seat belt on or does that have to be done by the dealer?

Mr. CHAYNE. That is part of the installation package, sir.

Mr. ROGERS. Have you ever made any investigation to determine the cost or the trouble that it might be to the factory to put an attachment on there to which a seat belt could very easily be attached?

Mr. CHAYNE. I assume that it has been done, but frankly I do not personally have any information as to what that study may have developed.

Mr. ROGERS. Mr. Chayne, speaking from the standpoint of an engineer, do you think it would be advisable if seat belts are an excellent safety factor, that the factory put some kind of an attachment on there to which a seat belt could be very easily attached or do you think that should be a matter for the dealer to do?

Mr. CHAYNE. It seems to me that that should be part of the installation job, because in some cases and in some cars there may be a difference in the type of attachment that you use, depending on whether you have the 2 or 3 seat belts per seat. That isn't always the case, but sometimes it is, and as the car structure and the car styling varies, that may vary.

Mr. ROGERS. Wouldn't it be a very nominal cost insofar as putting a bolt in place or providing a——

Mr. CHAYNE. You are not talking just about a bolt, sir. You are talking about reenforcements and properly supporting that bolt to members below the floor in order to spread the load. I mean just putting a bolt and a washer on the floor, with a crash stop it would probably pull right through. You would have to attach to structural reenforcements under the floor in order to spread the load.

Mr. ROGERS. I don't like to hear you talk that way. Whenever an automobile man talks that way I know the price of fixing the car is going up when he talks about a support supporting something else. I thought perhaps you could work out some sort of a situation where you could put some kind of an attachment on the frame, that it would make it very simple to attach seat belts to if we are moving into the thinking area that seat belts are a very necessary safety factor.

Mr. CHAYNE. Well, sir, that might seem to be so at first thought, but then when you stop to think that there are cars being manufac-

tured in this country and cars being imported into this country, and we are going to be importing some this fall, in which the frame is integral with the body and that poduces an entirely different picture.

Mr. ROGERS. Do you think, Mr. Chayne, from General Motors standpoint, that seat belts are such a safety factor that they should be included in all automobiles?

Mr. CHAYNE. I think, as Mr. Haynes said, that the real problem in seat belts is one of education, and I think that the public has got to want them before we can get the public to use them.

Mr. ROGERS. With relation to the questions that Mr. Friedel asked about selling automobiles without some of the safety devices such as indicated, direction signals and things of that kind, of course, I have a little different thinking on that. I think that much of that should be handled by not allowing taxicabs to appear on the streets of Baltimore or Washington or Philadelphia without certain safety devices, and that way you would have local situations that could be handled. Where traffic is heavy, these safety requirements could be made by the local authorities, and General Motors or Ford or American Motors or Chrysler Corp. could handle their sales accordingly.

I don't think you ought to move into the area of dictating to the country what it should do as a whole. I think it ought to be handled by the several localities. Of course, that goes also for the States insofar as some type of uniform code is concerned with relation to safety factors. It is not your premise to demand or refuse to sell a man an automobile if he says, "I want the automobile without any headlights at all," is it, Mr. Chayne?

Mr. CHAYNE. As far as something like headlamps, those are required by the State laws of all the States.

Mr. ROGERS. Yes; but then if he came in and said, "Now, Mr. Chayne, I want to buy 100 Chevrolets, and I don't want any headlights on them," you are not prohibited from selling him those cars without headlights?

Mr. CHAYNE. Oh, no.

Mr. ROGERS. He is prohibited from driving those cars on the highways?

Mr. CHAYNE. We know he can't have them registered.

Mr. ROGERS. He may have 100 sets of headlights he bought as a bargain some place.

Mr. CHAYNE. He may, quite so.

Mr. ROGERS. Thank you. That's all, Mr. Chairman.

Mr. ROBERTS. Thank you, Mr. Chayne.

The next witness is Mr. Roy C. Haeusler, safety engineer, Chrysler Corp.

Mr. FRIEDEL. Mr. Chairman, I would like to pass a remark on what my colleague said about Baltimore and certain other cities.

Mr. ROBERTS. This is off the record, I assume.

Mr. FRIEDEL. It can be off the record or on the record. I think Maryland can move forward in a lot of directions on known safety devices. We have a lot of antiquated laws. I don't want to take away the prerogatives of the legislature, but I think we could make great improvements in the State of Maryland.

Mr. ROBERTS. Mr. Haeusler, we are glad to have you as a witness before the subcommittee again. We are glad to renew our friendship.

We are very glad to have you here, and you may proceed with your statement.

STATEMENT OF ROY HAEUSLER, AUTOMOTIVE SAFETY ENGINEER, CHRYSLER CORP.

Mr. HAEUSLER. Mr. Chairman and members of the committee, I am Roy Haeusler, automotive safety engineer, Chrysler Corp. It is a pleasure to be here to appear before the committee again on the matter of automotive safety.

Concerning the current topic of effectiveness of seat belts in motor vehicles, you will recall that my testimony given before you last summer included the following statement:

> In certain areas of the problem of injury prevention we have had sufficient vehicle data on which to base decisions and take necessary development and design steps. One result has been the safety belt which we are proud to have introduced in April of last year (1955). We now know as a fact that safety belts properly designed, properly installed in the automobile and properly worn by the automobile occupant substantially reduce the possibility or severity of injury in highway accidents.

I would like to amplify this statement by several additional comments.

(1) It would appear that the primary basis of evaluating the effectiveness of seat belts must necessarily be the experience of those wearing the belts at the time of involvement in actual highway accidents. This experience must be compared with the experience of car occupants not wearing belts when involved in the same or closely similar accidents. This is the sort of information and the kind of comparison being provided by the crash injury research data that are collected by the State police and the State health departments in 15 participating States.

These data forwarded to the Cornell automotive crash injury research program for correlation and analysis have already been presented to your committee in summary form.

We consider these data to be essentially valid and representative and have therefore used them in guiding our own planning with regard to seat belts. In accepting these data and using them for our guidance, we recognize that they represent the statistical chances—the odds—of injury under one set of circumstances, that is, while wearing lap belts—as compared to another set of circumstances.

They cannot be used to predict the experience of any one individual. Accidents are extremely varied in their nature and we all recognize that some are so severe as to offer little likelihood of survival with or without seat belts.

Face to face head-on collisions and collisions into large trees and solid masonry walls are examples of this type of accident.

Fortunately they represent only a minor proportion of all injury-producing accidents.

Concerning other measures of effectiveness of seat belts, we feel they have validity only insofar as they can be shown to correlate properly with the data obtained from actual highway accidents. We refer here to simulated accidents of various types, whether rollover or collision.

(2) The effectiveness of seat belts depends on their adequate design and construction. The seat belt must be of sufficient strength as installed in the car and used by the occupant to insure the desired degree of restraint. Seat-belt strength and other performance and endurance qualities were spelled out a number of years ago in a standard applied to civil and commercial aircraft and known as CAA TSO-C22b. Initially it was this standard that was used by the Chrysler Corp. as a benchmark in designing and producing its seat belts.

Since that time the Society of Automotive Engineers committee on motor vehicle seat belts has developed and offered a recommended practice for motor vehicle seat belts. This specification was set up for the purpose of giving greater recognition to the problems specifically encountered in the application of seat belts to motor vehicles as contrasted with airplanes, while at the same time retaining the essential performance requirements.

Since the initial issue of the SAE recommended practice, a great deal of work was done leading to the ultimate issue of a more comprehensive and more adequately protective specification.

The results of this work have been seen in the recently issued first revision of the SAE Recommended Practice for Motor Vehicle Seat Belts. Moreover, the SAE committee has been actively continuing its work with the intent of providing an even more protective specification. In short, all through this period the industry has had ample guidance in the way of specification and recommended practice, even as it has acknowledged that there is room for further improvement.

Specifically, the Chrysler Corp. seat belts offered for all our vehicles have been designed and produced expressly with the new SAE recommended practice in mind, even though the most recent version of the SAE recommended practice had not yet been issued when the present seat belts were released for production.

(3) Seat belt effectiveness implies not only a positive virtue but also implies relative freedom from risk of being a direct cause of injury in itself. Aware of the demonstrated effectiveness of seat belts among stock car racing drivers and among stunt and thrill drivers, Chrysler Corp. felt the need of basing its decision to offer seat belts to the driving public on more adequate data, such as that obtained through research conducted by medical personnel.

Two sources of research data have been particularly helpful to us. One of these is a report issued in 1953 by the Cornell automotive crash injury research program, then under the direction of Mr. Hugh DeHaven. At that time the program was closely associated with a corresponding aviation crash injury research program. The DeHaven study herewith referred to is entitled "Aircraft Safety Belts: Their Injury Effect on the Human Body," by Hugh DeHaven, Boris Tourin, and Salvatore Macri.

Based on a study of 1,039 survivors of light plane crashes, ranging from moderate to extremely severe in nature, in which 1,000 survivors were wearing a 2-inch-wide lap-type safety belt with a loop holding capacity of 1,000 to 2,000 pounds, Mr. DeHaven reported that his statistical findings demonstrated that:

(1) The safety belt is not dangerous;

(2) The safety belt provides protection for the body in crashes; and

(3) Injuries which may have seemed related to safety belt directly actually are determined by other factors, such as safety belt installa-

tion failures and vertically acting forces in accidents (Mr. DeHaven was referring to the downward vertical forces associated with pancake-type crash landings).

Mr. DeHaven went on to point out in this report that—

> There is no correlation between severe snubbing action of safety belts (as evidenced by bruises and contusions of hips and abdomen) and the occurrence of intra-abdominal injuries or injuries of the lumbar spine * * *.

In appraising this report for its possible value and application to motor vehicle occupant protection, it is recognized that there are some important differences between motor vehicle crashes and light-plane crashes, especially with reference to the direction of vertical components. It appeared to us however that there was much in common between the two types of crash, particularly the predominance of a large horizontal forward deceleration component.

It is therefore felt that these findings had a direct bearing on our proposed application of seat belts to motor vehicles.

The work on human tolerance to linear deceleration by Lt. Col. John Paul Stapp now a colonel of the United States Air Force has strongly corroborated these earlier findings. Specifically, Colonel Stapp has demonstrated the feasibility of providing high deceleration through suitable restraint without undue risk of serious or fatal injury.

(4) Seat belt effectiveness is also heavily dependent on the purcase and use of seat belts by the ultimate users of the car. It is recognized that an excellent start has been made in this direction but it must also be recognized that a major educational job remains to be done before we can expect large scale use of seat belts. Since the mere presence of belts in the car is not sufficient and since we are heavily dependent on a high degree of continuous cooperation on the part of the driver and other car occupants, I feel it is very important to approach this whole problem through education and persuasion as the most effective method of accomplishing the desired end.

Thank you for this opportunity to express our views on this important safety device.

Mr. ROBERTS. Mr. Haeusler, you say it is recognized that an excellent start has been made in this direction. Do you have any idea or can you give us any estimate of how many of the perhaps 65 million drivers use automobile safety belts?

Mr. HAEUSLER. No, sir; I don't have a very good idea. I am thinking of the distinction between the number of cars so equipped and the number of drivers using them. It is my impression that the number of cars so equipped might be of the order of 500,000 to 1 million, but it leaves much to be desired in the way of information in view of the fact that we don't know the extent to which they are being used.

Mr. ROBERTS. On the basis of the number of vehicles registered, that would be about 2 percent, wouldn't it?

Mr. HAEUSLER. Roughly, yes, sir.

Mr. ROBERTS. I don't think that we can say it is an excellent start, do you, Mr. Haeusler?

Mr. HAEUSLER. I believe that it is in this sense, that this is the type of device different from most on the car, a type of device that requires close continuous cooperation. The mere decision to buy is not then at all sufficient. This is the sort of thing that requires

a change in the rather deeply rooted habits of the driving public. This requires an appreciation of the possibility that an accident might indeed occur "to me, the driver," a possibility that many drivers have tended to minimize, feeling that accidents occur to other people.

Mr. ROBERTS. But you would agree that you must do much better than 2 percent.

Mr. HAEUSLER. I think it would be highly desirable to do much better than 2 percent. Yes, sir.

Mr. ROBERTS. On page 3 you say:

> The seat belt must be of sufficient strength as installed in the car and used by the occupant to insure the desired degree of restraint.

Then you say:

> Seat-belt strength and other performance and endurance qualities were spelled out a number of years ago in a standard applied to civil and commercial aircraft known as CAA TSO–C22B.

And:

> This is the standard that Chrysler used as a benchmark.

Now why should there be any difference in adopting a minimum standard that everybody can comply with in the one case of aircraft injury as against automotive situations?

Mr. HAEUSLER. I don't know that there need be any difference. I think you have hit the heart of the matter when you mentioned the word "apply." The point I am making is that standards are indeed available for automotive as well as for aircraft. I think this is a question of their application.

Mr. ROBERTS. But in the one case in aircraft injuries, in aircraft situations we have just a nominal number of people who are killed every year in aircraft, and yet in automobiles you have 40,000 people killed a year, a million and a half injured, 200,000 of those perhaps permanently and totally injured and yet you say:

> We just recommend standards in the one case but we will go along with mandatory standards in the other.

It doesn't make sense to me.

Mr. HAEUSLER. It appears though there are two separate questions. One is the source of the standard and the other is the question as to whether the standard will be made mandatory, whether the equipment will be made mandatory. So far as the source of the standard is concerned, I think that one source might be as good as another, assuming of course, that both of those are highly competent sources. But merely having a highly competent source will be only a part of the job.

Mr. ROBERTS. I am not singling you out for this line of thinking, but it just seems to run throughout these hearings that you just more or less accept this business of recommending and hoping that somebody will catch onto the fact that by putting seat belts in their cars they may save their lives, and yet we do not object, we go right along with safety in the air and that is the place where we are killing a lesser number of people.

Yet on the highways where we are slaughtering so many people, we tend to hold back on requiring any mandatory safety standards. It just occurs to me that we need to change our thinking if we are going to get anywhere in this safety business.

I thank you for your statement.

Mr. Rogers?

Mr. ROGERS. May I reserve my time?

Mr. ROBERTS. Mr. Friedel?

Mr. FRIEDEL. Mr. Haeusler, I just want to ask one question, and I want to refer to page 3, practically the same thing that our chairman referred to:

> The seat belts must be of sufficient strength as installed in the car and used by the occupant to insure the desired degree of restraint.

Have you made a study or do you recommend to the public how to use the safety belt? Do you wear them tight, snug, or loose? How do you recommend that they be used when they are installed?

Mr. HAEUSLER. We recommend they be worn snugly, as snugly as consistent with comfort. We do so specifically in a sheet, an instruction sheet which is included with each and every safety-belt package along with the instructions for installation of the package, which by the way are very adequately and very amply worked out to insure proper installation.

Mr. FRIEDEL. I know that, but I just wanted to get in the record how it should be worn.

Mr. HAEUSLER. Yes; in addition to providing rather comprehensive installation information, we provide use information including the statement that these should be worn as snugly as consistent with comfort. That is the essence though I am not sure that is the exact choice of words.

Mr. FRIEDEL. Thank you very much.

Mr. ROBERTS. Mr. Rogers?

Mr. ROGERS. Mr. Haeusler, the light plane crashes which you referred to, 1,039 I believe you say were investigated?

Mr. HAEUSLER. Yes, sir.

Mr. ROGERS. How many of those would you say were crashes that would have involved death if the fellow had not had on a seat belt? Did you break them down in that manner?

Mr. HAEUSLER. This study which was run by Mr. DeHaven's organization at Cornell made no effort to predict or suggest how many of these survivors might not have survived.

It is an extremely difficult thing to do, to indicate what might have happened if it were not for some condition. He did indicate specifically what the experience was of these survivors, and to what degree the injuries could be ascribed to the belt and to what degree they might have occurred for entirely other reasons.

Mr. ROGERS. What I wanted to find out really was whether or not some of these crashes were such that they were light crashes you might say where the occupant probably wouldn't have been injured anyway, because we know lots of light planes crash and damage the plane beyond repair.

Yet they are not of such nature as to injure the occupant. It is really the manner in which the plane is built sometimes that causes so much damage rather than the crash.

Mr. HAEUSLER. Yes.

Mr. ROGERS. But you don't think that was the type of crash that they took into consideration in reaching this result?

Mr. HAEUSLER. I think the best measure of that is the information provided to indicate there was indeed extensive injury. In other words, this apparently was not material which was heavily loaded with a large content of noninjury accidents. There was considerable injury among these people.

They did, however, recover, in getting into this classification. These were survivors by title.

Mr. ROGERS. Now does Chrysler put attachments on their products to which safety belts can be attached if the purchaser wants to put them on?

Mr. HAEUSLER. We do not provide attachments. We do make provision for the installation of belts in that, for example, in our installation the belt webbing is attached to car structure by means of intermediate stranded steel cable. This cable passes through the seat structure on its way to the car structure in order that if the seat were to attempt to move forward beyond its normal forward position, as part of the crash circumstance, these cables would also restrain the seat assembly as well as the belts.

We have made specific provision in that the holes for the passage of these cables are provided so that the installer need merely perforate upholstery material over the perforated metal, pass cables through to finish the installation; these are holes in substantial steel structure which might be somewhat difficult to drill in the field.

Mr. ROGERS. And that is on all of your cars?

Mr. HAEUSLER. That is on all, yes.

Mr. ROGERS. What does that entail in the way of additional cost in your manufacturing process?

Mr. HAEUSLER. There is additional cost. I am not in a position to say what it is in the terms of cents or dolllars. It is a cost which in this case is limited by the fact that this is a hole punching operation rather than the addition of parts.

Mr. ROGERS. Mr. Haeusler, you feel, I believe, that as Mr. Haynes stated, and as Mr. Chayne stated, this is an educational matter, a matter of education of the public to make them understand the safety factor involved in seat belts and the desire of these seat belts. That is the position Chrysler has taken.

Mr. HAEUSLER. Yes, it is, sir.

Mr. ROGERS. Who do you think ought to pay for that educational program?

Mr. HAEUSLER. I am not sure I could give you a good recommendation as to where that cost might be placed or how it might be divided. I am sure that the agencies who are responsible for impartial information to the public would certainly do well to aid such a program.

Mr. ROGERS. What I am getting at is this, Mr. Haeusler. Do you think it is of such merit insofar as the possibilities are concerned that the substantial part of the cost ought to be borne by governmental agencies, whether State or Federal?

Mr. HAEUSLER. This would certainly seem to be an appropriate area for public education, yes, sir.

Mr. ROGERS. Now if we look at the cost operation, the $13 I believe as Mr. Haynes stated, how many automobiles do we produce a year and sell?

Mr. HAEUSLER. Approximately 6 million per year at the present state.

Mr. ROGERS. If those belts were required on each car, that would be a business item of $78 million?

Mr. HAEUSLER. Yes, sir.

Mr. ROGERS. I don't know what your profit is, but you wouldn't have to make but about 1 percent if you had that sizable amount of money involved.

Mr. HAEUSLER. You appreciate we have no objection whatever to selling additional equipment, none whatever, but I think we do like to look ahead a bit further. We are very conscious of the experience I believe presented before your very committee by another one of the manufacturers indicating that a closely similar type of belt had been offered, made part of another package, a reclining seat package, and that a subsequent survey roughly 1 year later indicated extremely low usage of those belt, and in fact a number of instances in which the belt had not only been pushed out of the way but physically removed from the car. I don't know that we have anything to gain by forceful efforts rather than by persuasion.

Mr. ROGERS. That is another thing that I was coming to in just a minute, as soon as we get off this cost.

The educational situation to me—I appreciate the fact that you all don't have any policy against selling additional equipment, and I certainly think that if you do, you should discard that policy, because I think you are in business to put out a product and service the people and I think you are doing a grand job, all of you. But I was just wondering about a field in which we could find some money to do this educational work, and what I was thinking about was whether or not we should put a tax on the seat belts that were sold which might help to defray the expenses.

You have got so many expenses and so many things that I know we will hear about that sooner or later if you pass any mandatory law saying a man has got to put a seat belt in his car and the manufacturer can't sell a car without a seat belt in it, I imagine the Congressmen are going to get a few letters in regard to that. The thing I am thinking about in addition to that is this, on the point you were making in regard to people taking those seat belts out of those cars if they were put in. A law requiring that seat belts be put in automobiles wouldn't have a great deal of effect unless you had a law requiring a man to wear them.

Mr. HAEUSLER. That's right.

Mr. ROGERS. And of course you would have to put them in the back seat and the front seat too so that the man in the back seat wouldn't be beyond the law and the man in the front seat covered by it. So actually you have a situation, Mr. Haeusler, that simply resolves itself to the proposition that you need some kind of regulation insofar as your municipalities or your States are concerned with relation to the use of these safety devices. Don't you think that's correct, sir?

Mr. HAEUSLER. I am not sure that follows. I am thinking as you speak of these things of the fact that in their application to the airlines, there has been the opportunity to escort the rider, as it were, and to remind him subsequently and persuasively and with an attractive method of presentation that it would be a good idea to put on the safety belt. This reminder has taken the form not only of the signs

but the stewardesses. And while I find that they get wholesale cooperation, I feel that the very fact that they are there, that they do provide the reminder provides the educational persuasion kind of thing that we need. I don't mean that there is hostility toward them, I mean that people need to be reminded to do things to take care of themselves.

Mr. ROGERS. Of course, a seat belt or safety belt in an airplane serves a little different purpose from that which it serves in an automobile.

Mr. HAEUSLER. It serves the additional purpose of course of providing for protection in bumpy weather, for example.

I don't think we can ignore the fact that it is intended also to provide some protection under crash circumstances.

Mr. ROGERS. I recall in regard to seat belts we were riding on a Russian plane and they didn't have seat belts in it and we through the interpreter asked why they didn't have seat belts and they said the pilots were so good they didn't need seat belts in the plane. It just happened that the Lord was with us that day and the weather was pretty good too. I think the Lord had much more to do with our smooth ride than the pilots.

Thank you very much, Mr. Haeusler.

Mr. ROBERTS. Thank you, Mr. Haeusler.

Dr. James L. Goddard, chief, accident prevention program, Public Health Service.

STATEMENT OF DR. JAMES L. GODDARD, CHIEF, ACCIDENT PREVENTION ACTIVITIES, UNITED STATES PUBLIC HEALTH SERVICE

Dr. GODDARD. Mr. Chairman and members of the committee, I am Dr. James L. Goddard, chief of the accident prevention program of the United States Public Health Service. I appreciate the opportunity to appear before this committee and inform you of some of the ways in which health departments are working with the many dedicated agencies and organizations attacking this most serious problem of highway safety. This will be a brief statement—not an attempt to cover the whole problem.

The Public Health Service through its accident prevention program is concerned with the injuries, disabilities, and deaths caused by accidents. Its objectives are twofold. First, to develop, through research, studies and investigation, knowledge of the human factors causing accidents, and apply the information so obtained to the reduction of accidents.

Second, to explore and make available to public health agencies and others, all possible techniques for reducing the occurrence and severity of injuries when accidents do occur. In connection with the latter objective, we have followed most carefully the progress of studies such as the Cornell crash injury research project, of which your committee is familiar. This project is supported in part by grant fund administered by the Public Health Service.

We were impressed by Mr. Moore's testimony before this committee last year, particularly the statistical evidence that use of automobile seat belts would reduce the chances of injury and severity of injury in highway crashes.

Correspondence from our field representatives about this time indicated there was a rising tide of interest in these safety devices among State agencies and Federal employees.

We found that in certain of our regional offices personnel were installing seat belts in their private cars; also, official cars were being so equipped, on a selective basis, where funds were available and supervisors had become convinced of the efficacy of this equipment.

In order to keep our field representatives and State health officials informed of developments in seat belt utilization, we provided them with significant data as it became available.

We also requested our consultants in regional offices that in the course of transmitting such data to State health departments, inquiries be made as to the extent of use of seat belts in official cars by State agencies.

Our first reports from field offices began to arrive in April. They indicated there was widespread interest in seat belt use, and that a significant number of official agencies are installing seat belts as standard equipment for their vehicles.

To date, we have had reports that in 20 States and in 1 Territory 1 or more agencies have installed seat belts in their official cars. In addition, it is reported that six other States will install seat belts upon an optional basis, or plan to use them in the near future.

I believe that some of the comments made to our staff by State health department officials indicate very clearly the desire of the public health profession to take advantage of all feasible methods for reducing the effects of accidents. Statements such as this are most encouraging. [Reading:]

> This Department has a policy whereby we furnish two seat belts for each leased automobile. This was adopted as a policy under our leased car plan at a staff meeting wherein every member in attendance agreed that this Department should be the first to instigate such safety measures.

Another State agency circulated this memorandum to all its employees:

> This upsurge of traffic fatalities in recent months has made us even more conscious of the need for all possible safety precautions. In line with this, the United States Public Health Service is encouraging the installation of seat belts in automobiles whenever possible. The Journal of the American Medical Association not only recommends that such equipment be installed in all automobiles, but goes on to say that "this feature would probably save more lives and limbs than any other single item."
>
> Since we believe safety should begin "at home" we have talked with two local companies which have agreed to install seat belts in any employee's car at a discounted price. If you are interested in taking advantage of this offer, we would suggest that you contact the accounting department for details.

The executive officer of a Midwestern State health department advised our regional director:

> All automobiles of the State health department as well as of the State highway patrol are equipped with seat belts. Some of the heavy trucks of the highway department such as snow plowing equipment are also equipped with belts.
>
> A few of our staff have safety belts in their private cars.
>
> I have pointed out to our State commissioner of administration the importance of utilizing all possible safety devices in an effort to reduce the severity of injuries and number of deaths in automobile accidents. It has been urged that the State should take some leadership in providing available safety devices, including safety belts, in all cars purchased by the State.

As evidence of the interest Federal agencies have taken in automobile seat belts, I would like to report that correspondence on this subject between Surgeon General Burney and General Services Administration Commissioner Floete was followed by an interagency conference on seat belts in October 1956.

The exchange of information and opinions by participants resulted in action by the General Services Administration to develop Federal specifications for passenger type seat belts and a Federal standard for their installation in motor vehicles. As soon as these tentative standards have received final approval, we plan to circulate to public health agencies information on their availability, through our usual channels.

In closing, I wish to emphasize that we do not look upon protective devices, like seat belts, as providing a complete solution to the problem of safety on the highways. However, after careful examination of evidence presently available both for and against their use, we are convinced that until more effective control measures for prevention of highway crashes have been developed, conscientious, intelligent use of carefully designed seat-belt installations will effect an appreciable reduction in the extent and severity of injuries when crashes do occur.

Mr. ROBERTS. Thank you, Dr. Goddard. I want to commend you for the very fine work you have been doing in the Department. I am sure that your efforts will meet with a great deal of success.

Now with reference to the part played in this picture by the States, I would like to say following your statement that the subcommittee has written to 20 States and Alaska which have installed seat belts on State-owned cars, asking them to state their reaction and experience in the use of seat belts. The subcommittee expects to include these replies from States in the official record of the seat-belt hearings. (See p. 213.)

I would like to state at this time that replies we have received so far are overwhelmingly in favor of the use of seat belts. We frequently hear the criticism, "You may install seat belt, but that doesn't mean they will be used."

Several replies from the States, however, indicate that, after several accidents where the individual walked away only because he had been wearing a seat belt, the other State employees were anxious to use seat belts at all times.

I want to thank you very much for your statement, and I want to say, too, that I am in agreement that some sort of a standard should be specified. I am glad to see that the Surgeon General is interested in seeing that there be some specifications developed to apply to those belts used in federally owned automobiles. I have no great pride of authorship in my particular proposal that the National Bureau of Standards be used.

However, as we all know, it is used by the public, by municipalities, and by the States and the Federal Government to do a great deal of testing and standardizing. Again I want to thank you for your effort in this field and for your very fine statement.

Mr. ROGERS. Dr. Goddard, do you feel that the interstate labor on this accident-prevention matter is of sufficient proportions to warrant Federal legislation on this subject?

Dr. GODDARD. Mr. Rogers, Federal legislation, of course, is not a function of the executive branch of the Government. I am certain

that, in viewing the proposals that have been prepared during this session of Congress, there will be Federal legislation of various types enacted in future years.

In careful review of the entire field of highway accident and highway safety, we can't say now that any specific Federal act would be indicated, clearly indicated.

I share your opinion, personally, that there is need for further extension of the uniform motor-vehicle code and such activities of this type.

Our emphasis, of course, is not, generally speaking, in Public Health Service on enforcement. We are more concerned with the education, the research that is necessary to develop the knowledge on which to base educational campaigns.

Mr. ROGERS. Your particular office is one of the reasons I asked you the question. Sometimes, if you ask an enforcement group as to their ideas about expanding their jurisdiction, you will always get a yes, because they like a little more power. But, in view of the fact that you have done such an outstanding job in this particular field, I felt that your advice on the subject would be very good, and, certainly, we appreciate the fact that the executive branch does not pass the legislation, but we always seek the advice of the departments before we move off into a new area.

Realizing the interstate matters that are involved in this situation, I was just wondering what the reaction of several States has been in regard to your work. Do you think they feel that perhaps some type of Federal legislation or help in that field is necessary?

Dr. GODDARD. We haven't had any occasion or expression on the part of the States that Federal legislation is needed. Their main concern at the present time is more assistance from the Federal level in their accident-prevention activities, particularly in the field of research and program development.

In other words, I am trying to say this, that we really don't know a great deal about highway safety today. We have come, then, a long way and I think the agencies concerned have done a very good job in holding the line, but if we are going to achieve any significant reduction in the fatalities and injuries, we have to probe much more deeply into this business of usage of motor vehicles by the American public. We have to mount a substantial research campaign, and then translate the information from this into programs at the local levels. I think the States and the Federal Government are partners in this effort.

Mr. ROGERS. You feel that the programs to which you refer, of course, encompass educational activities?

Dr. GODDARD. Definitely.

Mr. ROGERS. Do you feel, Doctor, that the problem is of such importance, insofar as the public is concerned, that a substantial part of the cost of the educational program should be borne by the public, that is from the tax coffers as different from the people who are selling the safety devices or the vehicles on which they are to be used?

Dr. GODDARD. As you have indicated, it won't be an either-or proposition. I do feel that the State and Federal Governments will bear a substantial cost of the educational campaign. We are talking about

one of the major public-health problems that confronts our Nation today, accidents of all types and, of course, motor-vehicle accidents are responsible for approximately 40 percent of the entire problem. Anything that affects the public to this degree must be of concern to health agencies at both the State and Federal levels.

(Discussion off the record.)

Mr. ROGERS. That's all, Mr. Chairman.

Mr. ROBERTS. Dr. Goddard, there is one feature of the Public Health Service work I would like to inquire about since you are a representative of the Health, Education, and Welfare Department.

During 1956, we passed what was known as the Health Survey Act.

Dr. GODDARD. Yes, sir.

Mr. ROBERTS. It was not made part of that legislation because we felt that showing the legislative intent in the report and in the hearings would be sufficient to the Department. But I would like to know if highway accidents, fatalities, or both, are being included in the statistical information that you are assembling now in connection with that legislation?

Dr. GODDARD. Yes, sir; a significant portion of the primary schedule of the national health survey is devoted to obtaining data on the accident experience of the respondents for a predetermined period of time prior to the interview. Now, this will of necessity incorporate data on home accidents as well as highway accidents. At a later date, after the primary schedule has been completed, we plan to request a special survey on highway accidents and possibly home accidents, too, a more detailed schedule of questions.

This is a rather important feature of the problem. There actually isn't good data today to tell us the numbers of injuries. The morbidity picture is very incomplete. We have good information on the fatalities, so we feel that the national health survey and its continuing activities will give us up-to-date, accurate information upon which to base our estimates of effectiveness of programs and estimates of need.

Mr. ROBERTS. Let me ask what are the mechanics through which you accomplish the gathering of this information?

Dr. GODDARD. The primary schedule of the national health survey, as others are, is based upon a person-to-person interview. The trained interviewers are assigned to certain areas, and a sample of predetermined size is drawn and they interview the persons incorporated in that sample. It is a highly technical matter, which I don't pretend to understand all the intricacies of, but it is statistically reliable and we think it will be extremely valuable.

Mr. ROBERTS. You work with the various State departments of health, then on through the county units, in obtaining this data?

Dr. GODDARD. I believe, Mr. Roberts, and I am not quite certain on this point, but it is my recollection from the mechanics of the survey that it is actually done directly by the employees of the Federal Government, field employees.

Mr. ROBERTS. Perhaps you would prefer to have someone else in the Department supply that for the record.

Dr. GODDARD. Yes, and I can obtain that and submit it to you for the record.

Mr. ROBERTS. It would be highly appreciated, Dr. Goddard. Again I want to thank you for your appearance here. This concludes the

hearings, and the subcommittee will stand in recess until 10 o'clock tomorrow morning and we will meet in this same committee room.

(The information requested of Dr. Goddard follows:)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
PUBLIC HEALTH SERVICE, BUREAU OF STATE SERVICES,
Washington, D. C., August 7, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Investigation of Highway Traffic Accidents of the Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: In response to your inquiry concerning activities of the national health survey program relating to automobile accidents and your request for information for the record of your subcommittee, we have collected a set of materials relating to the manner of conducting the household sample survey for the national health survey, the background of the program, the definitions and concepts employed, and a facsimile of the basic questionnaire form.

In reference particularly to the plans for collecting information on accidental injuries, the following comments are submitted:

1. The questionnaire for the household interview survey will consist of two parts: the basic items and the supplementary items. When the collection of data for publication began on July 1 the interview covered only the basic items. Later supplementary questions on particular topics will be added to the interview. These supplementary items on a particular topic will be carried on the questionnaire for a period of time necessary to build up a satisfactory sample size and then will be replaced by supplementary questions on a different topic.

In this way it is hoped to have a continuing series of statistics on the basic volume of illness and injuries, the disability resulting therefrom, and the medical care utilized in connection with the illnesses and injuries. The supplements will permit maintaining flexibility in the content of the survey so that many different program needs may be served.

2. The basic questionnaire will provide statistics on the volume of nonfatal accidental injuries involving motor vehicles and disability and medical care relating to these. It will also provide figures on the number of motor vehicle accident injuries requiring hospitalization. The number of days of disability, the number of days of hospitalization, the type of injury, and the number of residual impairments resulting from motor vehicle accident injuries will also be available.

These statistics will be obtainable by age, sex, size of city, farm versus nonfarm residence, income, veteran status, and other variables. National estimates will be produced for each calendar quarter (though not in as much detail) so that trends can be observed. Geographical distribution by regions of the country can be provided after data for 2 years have been accumulated.

3. The basic questionnaire will not, however, provide statistics on the type of automobile accident that produced the injury, nor upon the matter of whether the injured individual was a driver, passenger, or pedestrian, the type of highway, or other important characteristics of the accident. It is hoped that information on such items as these can be collected in a supplement to the basic questionnaire. Discussion on carrying out such a supplement will be initiated with the staff of the national health survey program as soon as the problems relating to the launching of the basic questionnaire survey can be solved.

4. The actual field work on this national survey is carried out by the Bureau of the Census, in line with our policy of making use of existing resources and skills whenever possible. In other phases of the national health survey program, particularly the special studies described on page 7 of the attached Public Health Reports reprint, there will be occasion to request the cooperation of State departments of health and departments of motor vehicles to make the maximum use of data that they have available that can be related to representative samples of the population.

I appreciate having had the opportunity to appear before your committee to testify on a subject of such major interest to the health and medical profession—that of preventing accidental injuries and deaths through the use of safety features in vehicles, with special attention to seat belts.

The Public Health Service offers full cooperation with your committee in its investigation of this important cause of death and disability.

Sincerely yours,

JAMES L. GODDARD, M. D.,
Chief, Accident Prevention Program,
Division of Special Health Services.

[Public Health Reports, January 1957]

THE NATIONAL HEALTH SURVEY ACT[1]

Within a few months, the Public Health Service will begin a survey of the health of the American people. On July 3, 1956, the President signed into law a bill authorizing a continuing survey of disease, injury, impairment, and disability in the United States. The program, located in the Division of Public Health Methods, will include a series of special studies to collect other detailed morbidity data and additional studies to evaluate the methods used in the survey.

HISTORICAL BACKGROUND

Twenty-one years ago last September, the last effort to obtain comprehensive statistics on illness in the general population was getting underway. The national health survey of 1935–36 was a tremendous undertaking in which interviewers visited 737,000 urban households to find out which members of the household had experienced disabling illness and which had specified chronic diseases or impairments.

In the years since the 1935–36 survey its findings have formed the basis for more than 200 reports, articles, and comparative studies. Even in recent years the urban statistics from that survey, generalized to the country as a whole and adjusted for population changes, have provided the only available estimates of the prevalence of many important diseases.

Although the national health survey of 1935–36 was by far the largest study ever devoted to learning the facts of illness and injury in the general population, it was not the first of its kind in this country. A number of smaller studies had demonstrated that the interview method can provide useful information about the amount and distribution of disease, the circumstances of injury, the loss of time from work or other usual activities resulting from disease and injury, and the utilization of medical care in connection with morbidity. Best known of these are the Hagerstown, Md., studies of the early 1920's and the survey made during the years 1928–31 by the Committee on the Costs of Medical Care.

The smaller, community-type studies continued after 1936, and additional refinements were made in the techniques. An important example of an intensive community study is the eastern health district study conducted in Baltimore by the Public Health Service and the Milbank Memorial Fund in the years 1938–43.

At the same time, great advances were made in the science of population sampling, with the Bureau of the Census leading the way in the development of practical methods for applying the theory of probability sampling in the field. In 1943 the Census Bureau, building upon an earlier survey by the Works Progress Administration, began to collect information on the labor force by conducting interviews each month in a national sample of households. Now known as the current population survey, that survey, almost from its start, was used to satisfy some of the growing demand for national morbidity statistics by adding, from time to time, questions on illness to the basic questionnaire. As recently as September 1956 the current population survey carried a supplement dealing with the utilization of hospital care.

Neither the intensive community studies nor the occasional limited data supplied by adding questions to the current population survey were capable of filling the increasing needs. Public health programs, both public and private, and health-insurance plans, medical research efforts, and programs to conserve manpower were increasing in scope. A broader statistical base was needed for the planning and evaluation of these programs.

Furthermore, the national data collected in 1935 and 1936 were becoming increasingly inappropriate as descriptions of the current health of the population as a whole. Two wars, the wonder drugs, returning prosperity, and a great

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[1] Prepared by the Division of Public Health Methods, Office of the Surgeon General, Public Health Service.

increase in the proportion of the population covered by hospitalization insurance brought changes whose effect on morbidity could not be measured. Overweight, smoking history, exposure to air pollution, and other aspects of the environment scarcely touched on in the earlier surveys had become significant factors in epidemiology.

THE NATIONAL COMMITTEE

In January 1949 the United States National Committee on Vital and Health Statistics was established. Recognizing the obsolescence of the existing data, the committee gave immediate attention to the problem of obtaining adequate national morbidity statistics. Two successive ad hoc subcommittees were set up by the chairman of the national committee "to frame the problems in morbidity statistics, including chronic diseases and medical care statistics, in order that morbidity data may be directly related to demographic factors." These subcommittees recommended study of a number of methodological questions, but, even as the recommendations were being made, steps were being taken in several parts of the country to get some of the answers in community surveys. About the same time a bill calling for an 18-month study of methods of measuring illness passed the Senate but failed of passage in the House of Representatives.

Within the next few years, sample surveys of illness were initiated in New York City, in San Jose, Calif., in Hunterdon County, N. J., and in Pittsburgh. Every one of these, as well as later surveys in Baltimore, Kansas City, and in the State of California contributed to the knowledge of how such data collection can be made more accurate and useful.

Anticipating the solution of the methodological problems raised in and the ad hoc subcommittees, the chairman of the national committee, in February 1951, established the Subcommittee on National Morbidity Survey and charged it with the drafting of "a plan for a national morbidity survey keeping in view the interests of local areas." It was the report of this group that led to the proposal for specific legislative authorization for a continuing national program. This report,[2] which is the basis for the present national health survey, contains a valuable list of the major applications of morbidity statistics.

PROVISIONS OF THE ACT

The Department of Health, Education, and Welfare proposed in the summer of 1955 legislation specifically authorizing the Surgeon General of the Public Health Service to conduct a continuing survey of illness and disability in the Nation. A bill was drafted, made part of the President's legislative program on health matters, and introduced in both Houses of Congress in February 1956. The few amendments added tended to strengthen the bills,[3 4] which passed the Senate in March and the House of Representatives in June. The Senate concurred in the House changes, and on July 3 the President signed the bill. In late July, Congress appropriated funds for the first fiscal year of operation.

The major provisions of the National Health Survey Act follow:

"(*a*) The Surgeon General is authorized * * * to make, by sampling or other appropriate means, surveys and special studies of the population of the United States to determine the extent of illness and disability and related information * * * and * * * in connection therewith, to develop and test new or improved methods for obtaining current data on illness and disability and related information.

"(*b*) The Surgeon General is authorized, at appropriate intervals, to make available, through publications and otherwise * * * the results of surveys or studies made pursuant to subsection (*a*).

"(*c*) For each fiscal year * * * there are authorized to be appropriated such sums as the Congress may determine for carrying out the provisions of this section.

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[2] U. S. National Committee on Vital and Health Statistics, Subcommittee on National Morbidity Survey: Proposal for collection of data on illness and impairments: United States. A report of the subcommittee. PHS Publication No. 333. Washington, D. C., U. S. Public Health Service, 1953.

[3] U. S. Congress, Senate: Continuing survey and special studies of sickness and disability in the United States, Rept. No. 1718 to accompany S. 3076, 84th Cong., 2d sess., Washington D. C., U. S. Government Printing Office, 1956.

[4] U. S. Congress, House of Representatives: National Health Survey Act, Rept. No. 2108 to accompany S. 3076, 84th Cong., 2d sess., Washington, D. C., U. S. Government Printing Office, 1956.

"(*d*) To assist in carrying out the provisions of this section the Surgeon General is authorized and directed to cooperate and consult with the Departments of Commerce and Labor and any other interested Federal departments or agencies and with State health departments. For such purpose he shall utilize insofar as possible the services or facilities of any agency of the Federal Government and * * * of any appropriate State or other public agency, and may * * * utilize the services or facilities of any private agency, organization, group, or individual, in accordance with written agreements * * *."

Public Law 652 is in the form of an amendment, as section 305, to the Public Health Service Act of 1944 (Public Law 410, 78th Cong.). It also amends another section of the basic act by authorizing the Surgeon General to "make available, to health officials, scientists, and appropriate public and other nonprofit institutions and organizations, technical advice and assistance on the application of statistical methods to exepriments, studies, and surveys in health and medical fields." In addition it is important to note that Public Law 652 provides that information collected under the authority of the act is to be obtained "on a noncompulsory basis."

Organization of National Health Survey

The three types of activity authorized in the National Health Survey Act have as their purpose the obtaining of "accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States and the services received for or because of such conditions."[1] These three activities—a sample survey of the population, a series of special studies, and the development and testing of new or improved methods for obtaining current data—constitute the national health survey program. To plan and direct the program, a small, experienced staff is being recruited in the Division of Public Health Methods of the Public Health Service.

The nucleus of the staff is already at work, drafting plans to implement the act. Successful execution of the program will require the assistance of health departments, the medical and dental professions, hospitals, and many other sources of healthful information. It is the understanding and cooperation of the general public, however, that is the most important ingredient of success.

The Bureau of the Census is providing expert help in designing the sample survey of the population. Technical consultants will give advice on all methodological aspects of the program. Three advisory committees will review the plans, keep the staff informed of needs for statistics which the program is capable of filling, and advise on obtaining the cooperation of professional groups and the public. One advisory committee will be drawn from operating agencies within the Department of Health, Education, and Welfare. A second committee will comprise representatives of all Federal departments and agencies having an interest in the data to be supplied. The third committee will be made up of leaders from the professions and business and from State and local governmental fields.

In addition to those consultants and committees, the program staff will have frequent discussions with individual agencies and groups about ways in which the program can be made more useful.

Planning for the three phases of the national health survey program is now going on. First priority is being given to setting up the sample survey of the population. Methodological studies are, of course, an essential part of the planning process and will continue throughout the program since improving the techniques and adding to the usefulness of the results should never be considered to be complete. Collection of data for the series of special studies will not begin until after the sample survey is underway.

Despite the fact that decisions on various points are not yet final, it is possible to describe now, in general terms, the plans for the program.

The Household Survey

The sample survey phase of the program will consist of a continuous sampling of households on a national basis. Information will be collected in each household by carefully trained and supervised interviewers. The Bureau of the Census is devising sampling and field interviewing plans and preparing instruc-

[1] National Health Survey Act, Public Law 652, 84th Cong., 2d sess., Washington, D. C., U. S. Government Printing Office, 1956.

tion and training manuals. The Bureau will hire and train interviewers, supervise the field work, edit and code the questionnaires, and produce the required tabulations. The Public Health Service is responsible for the content of the survey questionnaire, for content of the tabulations that will be made of the replies, and for the analysis and publication of the results.

Fieldwork on the household survey will start with pretesting activities on a small scale in early 1957. A "dry run" on a national scale will follow later in the spring. Collection of statistical information for periodic publication will begin about July 1.

The questionnaire

When the household survey is in full operation, the questionnaire for the interview will consist of two parts, core items and supplements. Core items will include only the most basic types of information and will remain on the questionnaire for a long period of time. During the dry-run period of the survey, only core items will be on the questionnaire.

The core questionnaire, as presently planned, will provide information on the incidence of illnesses and injury involving either medical care or loss of time from usual activities (for example, the number of days lost from work or school), or both. The prevalence of chronic conditions known to the family and of various types of impairments will be obtained to the extent that they have caused trouble for the individual within a year preceding the interview. Persons with chronic conditions will be classified according to the degree to which these conditions have limited their activities.

In addition, core questions will ascertain the number of visits to physicians and dentists and the number and duration of hospital stays as well as the number of operations performed while the family member has been in the hospital.

These various measures of illness, disability, and medical care will be classifiable, on the basis of information collected in the core questionnaire, by age, sex, race, marital status, educational attainment, income, occupation, and industry for those in the labor force, by usual activity for those not in the labor force, and by residence in farm and nonfarm areas. The illness will also be classifiable by diagnosis in broad groups and by physician attendance.

After the dry run, the questionnaire will be opened for special supplementary inquiries. In this way, flexibility in content can serve the interests of additional users of the data. The supplements may be repeated at regular intervals or may be included once only. Since the total amount of interviewing in any one month will be relatively small, supplements may remain on the questionnaires for 3 months or longer depending on the degree of geographic detail required.

Collection of data

Initially, the sample of households will be selected within the 330 areas (counties, parts of counties, or metropolitan areas) that constitute the first stage of sampling for the current population survey of the Census Bureau. The current population survey has for some years been collecting information, from a national sample each month, on employment, unemployment, and other economic data. Except very rarely, and then by chance, the households interviewed for the national health survey will not be the households sampled in the current population survey.

After the dry run, which has as its major purpose the establishment of smoothly operating procedures, the household survey will be expanded gradually over a 6-month period until it includes approximately 400–450 sample areas known as primary sampling units. The reason for this difference in the design of the two national samples is that the national health survey will require estimates in greater geographic detail than the current population survey.

The number of interviews in the primary sampling units will be far fewer than in the current population survey. The interview rate during the dry run will be approximately 3,000 households a month for the country as a whole. By the end of 1957 it is hoped to increase the rate to about 3,500 households a month. This is in contrast to the 35,000 households interviewed each month in the current population survey.

A careful control on the quality of the interviewing will be maintained by a regular program of reinterviews, and other devices, in a subsample of the households.

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Publication of data

The present plan is periodically to publish separate morbidity statistics for each of nine standard metropolitan areas: New York, Chicago, Los Angeles, Philadelphia, Detroit, San Francisco, Boston, Pittsburgh, and the combined Washington, D. C.-Baltimore area. In addition, separate statistics will be published periodically for each of 11 geographic regions of the country. These correspond to the 9 standard geographic "divisions" of the Census Bureau, except that the east north central division and the South Atlantic division each will be divided into 2 parts. Data from the regions will be shown separately for large metropolitan areas as a group, all other urban areas as a group, and rural areas.

To publish statistics in this maximum geographic detail, it will be necessary to accumulate data for a period of 2 years. However, summary statistics may be presented at more frequent intervals for four major Census Bureau regions of the country (Northeast, North Central, South, and West) as well as by size of place, in terms of population, for the country as a whole.

According to present plans, the most frequent publication of any particular statistical table will be at intervals of 3 months. Data for the preceding calendar quarter will be included. These published tables will be devoted to information for which it is desirable to show quarter-to-quarter change. An example might be the frequency of injuries resulting from automobile accidents.

SPECIAL STUDIES

The special studies will produce auxiliary information of a type that the household interview cannot provide. They will be based either on subsamples of the national household sample or on separate samples. Though they may vary in nature, all special studies will be based upon scientifically designed samples so that the results can be generalized to a defined population. They will emphasize the measurement of disease by means of clinical tests, physical examinations, or the analysis of medical records. The entire health-survey program is planned as an integrated system in which the special studies will supplement the data obtained in household interviews.

Because of wide interest in the prevalence of chronic disease and impairments, including conditions not yet diagnosed, the first of the special studies will be designed to provide a thorough medical and dental evaluation by a professional team for a cross-sectional sample of persons of all ages. The need for statistics on undiagnosed and nonmanifest conditions has been emphasized by the Subcommittee on National Morbidity Survey.[2] Two recent surveys, one in Hunterdon County, N. J., and one in Baltimore, have demonstrated that, in conjunction with a household interview survey, the medical evaluation of a subsample can produce useful data.

The staff of the national health survey program will conduct the studies with the help of field personnel employed for each study. Part of the work, however, such as the abstracting of medical records, may be contracted to organizations with access to the information needed.

Although first priority is being given to the household survey, staff and consultants of the program have begun to design the first of the special studies for the national health survey. Field work on this study, however, probably will not begin before late 1957.

METHODOLOGICAL STUDIES

The third phase of the program will include methodological experiments in connection with the national household survey; studies to determine the nature and magnitude of errors of measurement associated with clinical tests and physical examinations; matching of data from one source against data from another; and basic investigation of entirely different methods of measurement, such as panels of physicians keeping records concerning the patients under their care.

The methodological studies will be conducted sometimes alone by the staff of the national health survey program, and at other times in conjunction with the Bureau of the Census or other organizations. Some methodological problems

[2] U. S. National Committee on Vital and Health Statistics, Subcommittee on National Morbidity Survey: Proposal for collection of data on illness and impairments: United States. A report of the subcommittee. PHS Publication No. 333, Washington, D. C., U. S. Public Health Service, 1953.

may be investigated by schools of public health, health departments, health insurance agencies, or research groups employed on a contract basis.

LIMITATIONS OF THE PROGRAM

"It is clear that this legislation would close a major gap in our population and health statistics. We have available today only piecemeal data—from special studies and surveys, from reports on particular kinds of diseases, or from records kept for a variety of purposes on particular segments of the population." [3]

"A national health survey based on a representative sample of the total population would provide a comprehensive picture of illness, both with respect to coverage of the population and to inclusion of the entire range of types of illness. As such it will supplement and extend existing sources of health data." [4]

These statements appeared in the Senate and House of Representatives reports on the proposed national health survey. However, recognition of the potential value of the survey in defining more clearly the extent of illness and disability in the Nation should not obscure the fact that the program has definite limitations.

The size of the national sample, for example, is such that estimates in greater geographic detail than planned cannot be made without enlarging the sample for that purpose. Moreover, the sample cannot provide independent information concerning persons in small groups of the population or for diseases of low frequency.

Further, there are limitations to the accuracy of diagnostic information collected in household interviews. The household respondent, at best, can pass on to the interviewer only the information the physician has given to the family. For conditions not medically attended, diagnostic information is often no more than a description of symptoms. Facts concerning the circumstances of the illness or injury and the resulting action taken by the individual, such as going to bed or seeing a physician, can be obtained more accurately from household members than from any other source. However, when clinical detail or diagnoses for unattended or nonmanifest illness are required, information procured by interview does not substitute for a medical examination. For this reason, information collected in the special studies, for example, by physical examinations and clinical tests, will supplement the results from the household survey.

The statistics from the program will not provide critical tests of clinical and epidemiological hypotheses. For example, the program could not test the hypothesis that a specific vaccine would prevent a certain disease. For this, an experimental design, a control group, and similar conditions would be required. The program may, however, suggest hypotheses that can be tested by other appropirate means. Information that is required quickly for corrective action, as in an epidemic, will have to come from other sources, such as the notifiable disease reporting system.

The program is intended to supplement existing sources of information and provide a background of broadly based illness statistics. It does not purport to replace the many ad hoc studies now being conducted.

Aside from such limitations as these, imposed by the methods to be used and the resources available, the program is free to collect any statistics on the incidence, prevalance, or other measures of disease, injury, or impairment, the disability or other effects of this morbidity, and the medical care used in its treatment. The sole guide is the usefulness of the data.

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[3] U. S. Congress, Senate: Continuing survey and special studies of sickness and disability in the United States. Rept. No. 1718 to accompany S. 3076, 84th Cong., 2d sess., Washington, D. C., U. S. Government Printing Office, 1956.

[4] U. S. Congress, House of Representatives: National Health Survey Act. Rept. No. 2108 to accompany S. 2076, 84th Cong., 2d sess., Washington, D. C., U. S. Government Printing Office, 1956.

Department of Health, Education, and Welfare
Public Health Service
Division of Public Health Methods

National Health Survey Program
April 15, 1957

ILLUSTRATION OF CONTENT OF INITIAL BASIC HOUSEHOLD QUESTIONNAIRE

The items below show the exact content and wording of the initial basic questionnaire used in the nationwide household survey of the National Health Survey Program. The actual questionnaire is designed for a household as a unit and includes additional spaces for reports on more than one person, condition, accident or hospitalization. Such repetitive spaces are omitted in this illustration.

CONFIDENTIAL: The National Health Survey is authorized by Public Law 652 of the 84th Congress (70 Stat 482; 42 U.S.C. 242). All information which could permit identification of the individual will be held strictly confidential, will be used only by persons engaged in and for the purposes of the survey, and will not be disclosed or released to others for any other purposes (22 FR 1007).

Form NHS-1 (3-10-57)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
Acting as Collecting Agent for the U.S. PUBLIC HEALTH SERVICE

NATIONAL HEALTH SURVEY

1. Questionnaire ____ of ____ Questionnaires

2. (a) Address or description of location

3. Ident. Code | 4. Sub-sample weight | 5. Sample | 6. PSU Number | 7. Segment No. | 8. Serial No.

9. Is this house on a farm or ranch? ☐ Yes ☐ No

10. (a) Type of living quarters: ☐ Dwelling unit ☐ Other
(b) Name of Special Dwelling Place | Code

11. What is the telephone number here? ☐ No phone

12. What is the best time to call?

13. Are there any other living quarters, occupied or vacant, in this building (apartment)? ☐ Yes ☐ No

Ask at all units except apartment houses
13. Is there any other building on this property for people to live in - either occupied or vacant? ☐ Yes ☐ No

14. Does anyone else living in this building use THIS DOORWAY to get to his living quarters? ☐ Yes ☐ No

INSTRUCTIONS
If "Yes" to questions 13, 13 or 14 apply definition of a dwelling unit to determine whether one or more additional questionnaires should be filled and whether the listing is to be corrected.

15. RECORD OF CALLS AT HOUSEHOLD

Item		1	Con.	2	Con.	3	Con.	4	Con.	5	Con.
Entire Household	Date										
	Time										
Callbacks for individual respondents	Col. No. ____ Date										
	Time										

16. REASON FOR NON-INTERVIEW

TYPE:	A	B	C	D
Reason:	☐ Refusal ☐ No one at home - repeated calls ☐ Temporarily absent ☐ Other (Specify)	☐ Vacant - Non-seasonal ☐ Vacant - seasonal ☐ Usual residence elsewhere ☐ Armed Forces ☐ Other (Specify)	☐ Demolished ☐ In sample by mistake ☐ Eliminated in sub-sample ☐ Other (Specify)	Interview not obtained for: Cols. ____ ____ ____ ____ ____ because:

Comments on non-interview

17. Signature of Interviewer: | 18. Code:

Special instructions or notes

EDITING RECORD FOR OFFICE USE ONLY

a. Result of edit	b. Type of follow-up	d. Edited	e. Re-edited	f. Re-edited
☐ Passed ☐ Passed (EFU) ☐ Failed - no follow-up ☐ Failed - follow-up	☐ Office telephone ☐ Interviewer telephone ☐ Personal	Editor	Editor	Editor
	c. Result of follow-up ☐ Completed ☐ Non-interview	Date	Date	Date

5. (a) What is the name of the head of this household? (Enter name in first column)
(b) What are the names of all other persons who live here? (List all persons who usually live here, and all persons staying here who have no usual place of residence elsewhere. List these persons in the prescribed order.)
(c) Do any (other) lodgers or roomers live here? ☐ No ☐ Yes (List) →
(d) Is there anyone else who lives here who is not away on business? On a visit? Temporarily in a hospital? ☐ No ☐ Yes (List) →
(e) Is there anyone else staying here now? ☐ No ☐ Yes (List) →
(f) Do any of these people have a home elsewhere?
☐ No (Leave on questionnaire) ☐ Yes (If not a household member, delete)

Last name

First name and initial

6. How are you related to the head of the household? (Enter relationship to head, for example: head, wife, daughter, grandson, mother-in-law, partner, lodger, lodger's wife, etc.)

Relationship

7. Race (Check one box for each person)

☐ White ☐ Negro ☐ Other

8. Sex (Check one box for each person)

☐ Male ☐ Female

9. How old were you on your last birthday?

Age ☐ Under 1 year

10. Where were you born? (Record state or foreign country)

(State or Foreign country)

If 14 years old or over, ask:

11. Are you now married, widowed, divorced, separated or never married? (Check one box for each person)

☐ Under 14 years
☐ Married ☐ Divorced
☐ Widowed ☐ Separated
☐ Never married

If 14 years old or over, ask:

12. What is the highest grade you completed in school? (Circle highest grade completed or check "None")

☐ Under 14 years

Elem: 1 2 3 4 5 6 7 8
High: 1 2 3 4
College: 1 2 3 4 5+
☐ None

If Male and 14 years old or over, ask:

8. (a) Did you ever serve in the Armed Forces of the United States? ☐ Yes ☐ No
If "Yes," ask:
(b) Are you now in the Armed Forces, not counting the reserves? ☐ Yes ☐ No
(If "Yes," delete this person from questionnaire) →
(c) Was any of your service during a war or was it peace-time only? ☐ War ☐ Peace-time only
If "War," ask:
(d) During which war did you serve? ☐ Spanish American ☐ WW-II ☐ WW - I ☐ Korean
If "Peace-time" only, ask:
(e) Was any of your service between June 27, 1950 and January 31, 1955? ☐ Yes ☐ No

If 6 years old or over, ask:

9a. (a) What were you doing most of the past 12 months -- ☐ Under 6 years
(For males over 16): working, looking for work, or doing something else? ☐ Working ☐ Looking for work
(For females over 16): working, looking for work, keeping house, or doing something else? ☐ Keeping house
(For children 6 - 15): going to school or doing something else? ☐ Going to school
If "Something else" checked, had person in 10 years old or over, ask: ☐ Something else
(b) Are you retired? ☐ Yes ☐ No

I — Interview each adult person for himself for questions 11-26 and Tables I, II, and A, if he is at home. Enter column number of respondent in each column. ☐ Respondent for self; Col. No. _____ was respondent

Do you interested in all kinds of illness, whether serious or not --

10. Have you sick at any time LAST WEEK OR THE WEEK BEFORE? ☐ Yes ☐ No
(a) What was the matter?
(b) Anything else?

11. Last week or the week before did you have any accidents or injuries, either at home or away from home? ☐ Yes ☐ No
(a) What were they?
(b) Anything else?

12. Last week or the week before did you feel any ill effects from an earlier accident or injury? ☐ Yes ☐ No
(a) What were these effects?
(b) Anything else?

13. Last week or the week before did you take any medicine or treatment for any condition (besides...which you told me about)? ☐ Yes ☐ No
(a) For what conditions?
(b) Anything else?

14. AT THE PRESENT TIME do you have any ailments or conditions that have continued for a long time? (If "No") Even though they don't bother you all the time? ☐ Yes ☐ No
(a) What are they?
(b) Anything else?

15. Has anyone in the family - you, your--, etc. - had any of these conditions DURING THE PAST 12 MONTHS? ☐ Yes ☐ No
(Read Card A, condition by condition; record any conditions mentioned in the column for the person)

16. Does anyone in the family have any of these conditions? ☐ Yes ☐ No
(Read Card B, condition by condition; record any conditions mentioned in the column for the person)

Table I - ILLNESSES, IMPAIRMENTS AND ACCIDENTS

Line Number	Col. No. of Person	Question No.	Did you ever talk to a doctor about ...?	What did the doctor say it was? -- did he use any medical terms? (If doctor not talked to - "No," in col. (c)-- record respondent's description) (If ill-effects of earlier accident also fill Table A) For an accident or injury occurring during past 2 weeks, ask: What part of the body was hurt? What kind of injury was it? Anything else? (Also, fill Table A) (c-1)	If an impairment or symptom, ask: What was the cause of ...? (If cause is already entered in (d-1) circle "X" without asking the question) (If accident or injury, fill Table A) (c-2)	(If eye trouble of any kind and 9 years old or over, ask:) Can you read ordinary newspaper print with glasses? (c-3)	What kind of ...trouble is it? (If kind of trouble already entered in col. (c-1), circle "X" without asking the question) (c-4)	What part of the body was affected? (If part of body can be determined from entries in cols. (c-1) through (c-4), circle "X" without asking the question) (c-5)	LAST WEEK OR THE WEEK BEFORE did ...cause you to cut down on your usual activities for as much as a day? Check one: No (Go to Col. (f)) (e) / Yes (f)
(a)	(b)	(c)							
I			☐ Yes ☐ No		I	☐ Yes ☐ No	I	I	

Table II - HOSPITALIZATION DURING PART 12 MONTHS

Line Number	Col. No. of Person	Question No.	How did you enter the hospital? (Month, Year) (b)	How many days were you in the hospital, not counting the day you left? (c)	To Interviewer: How many of these--days were you at work in the past 12 months? (d)	How many of these--days were during the past 2 weeks, ending last Sunday? (e)	Was this person still in the hospital last Sunday night? (Verify that by back, fore after Sunday are in Col. (d)) (f)	What was the matter? Anything else? (Record each condition in some detail as called for in Table I. If condition is result of accident or injury, also fill Table A) (g)
(a)								
I			Mo. _____ Year _____	_____ Days	☐ All or _____ Days	_____ Days	☐ Yes ☐ No	

TABLE A (Accidents and Injuries)

Line No. from Table I: _____

1. What part of the body was hurt? What kind of injury was it? Anything else? ☐ Accident happened during past 2 weeks

2. When did it happen? Month _____ Year _____ (Enter only the year if prior to 1950) ☐ Accident happened during past 2 weeks

3. Where did the accident happen?
☐ At home (inside or outside the house) ☐ While in Armed Services ☐ Some other place

4. Was a car, truck, bus or other motor vehicle involved in the accident in any way? ☐ Yes ☐ No

5. Were you at work at your job or business when the accident happened? ☐ Yes ☐ No ☐ Under 14 years at time of accident

MEDICAL CARE

18. (a) LAST WEEK OR THE WEEK BEFORE did anyone in the family - you, your--, etc. - talk to a doctor or go to a doctor's office or clinic? Anyone else?
If "Yes"
(b) How many times during the past 2 weeks?
☐ Yes ☐ No (skip to Q.20)
_____ No. of times

(c) Where did you talk to the doctor?
(d) How many times at -- (home, office, clinic, etc.)?
(Record total number of times for each type of place)

Place	Times
At home	
At office	
Hospital clinic	
Company or industry	
Over telephone	
Other (Specify)	

19. What did you have done?
If more than one visit or telephone call:
What did you have done on the (first / second / etc.) visit (or telephone call)?

(1) (2) (3)
☐ ☐ ☐ Diag. or treatment
☐ ☐ ☐ Pre/post natal care
☐ ☐ ☐ Gen'l check-up
☐ ☐ ☐ Immun./Vacc.
☐ ☐ ☐ Eye exam. (glasses)
☐ ☐ ☐ Other (Specify)

20. If "Yes" to Q. 18a, ask:
How long has it been since you last talked to a doctor?
_____ Hrs. or _____ Yrs.
☐ Less than 1 hr. ☐ Never

DENTAL CARE

21. (a) Last week or the week before did anyone in the family go to a dentist? Anyone else?
If "Yes"
(b) How many times during the past 2 weeks?
☐ Yes ☐ No (skip to Q.22)
_____ No. of times

22. What did you have done?
If more than one visit:
What did you have done on the (first / second / etc.) visit?

(1) (2) (3)
☐ ☐ ☐ Fillings
☐ ☐ ☐ Extractions or other surgery
☐ ☐ ☐ Straightening
☐ ☐ ☐ Treatment for gums
☐ ☐ ☐ Cleaning teeth
☐ ☐ ☐ Other (Specify)

If "No" to Q. 21a, ask:
23. How long has it been since you went to a dentist?
_____ Hrs. or _____ Yrs.
☐ Less than 1 hr. ☐ Never

24. Is there anyone in the family who has lost all of his teeth?
☐ Yes ☐ No

HOSPITAL CARE

25. (a) DURING THE PAST 12 MONTHS has anyone in the family been a patient in a hospital overnight or longer?
If "Yes":
(b) How many times were you in the hospital?
☐ Yes (Table II) ☐ No
_____ No. of times

26. (a) During the past 12 months has anyone in the family been a patient in a nursing home or sanitarium?
If "Yes"
(b) How many times were you in a nursing home or sanitarium?
☐ Yes (Table II) ☐ No
_____ No. of times

27. During the past 12 months in which group did the total income of your family fall, that is, your's, your --'s, etc.? (Show Card H) Include income from all sources, such as wages, salaries, rents from property, pensions, help from relatives, etc.
Group No.

Table I - ILLNESSES, IMPAIRMENTS AND ACCIDENTS

How many days, including the 2 weekends? (12)	How many of these -- days were you in bed all or most of the day? (5)	If 6 years old or over, ask: Last week or the week before could you have been working at a job or business (going to school) except for ...? (1)	If "Yes" to col. (1): How many days did ... keep you from work (going to school)? (2)	Did you first notice ... DURING THE PAST 3 MONTHS or before that time? Check one: Before 3 months (Go to col. (3)) (3)	During 3 months (4)	Did ... start during the past 2 weeks or before that time? (If during past 2 weeks, ask:) Which week, last week or the week before? (6a)	To interviewer: If Col. (3) is checked or the condition is on either one of Cards A or B, continue; otherwise, STOP (6b)	Did you first notice ... DURING THE PAST 12 MONTHS or before that time? (If during past 12 months, ask:) Which month? (8)	When did you last talk to a doctor about ...? (Month and year - Year only if prior to 1960) (9)	Do you still take any medicine or treatment for ...? Or, follow any advice he gave? (10)	About how many days during the past 12 months, has ... kept you in bed for all or most of the day? (12)	Please look at this card and read each statement. Then tell me which statement fits you best. (Show Cards C-F, on separate prints) (7)	If "1," or "2" or "3" or "4" or "5" prior to Col. (7) ask: Please look at this card and tell me which of these statements fits you best. (Show Card G) (8)	Line Number
_____ Days	_____ Days or ☐ None	☐ Yes ☐ No	_____ Days or ☐ None			☐ Last ☐ Before 2 wks. ☐ Week before		Mo. _____ Yr. _____ ☐ Before ☐ Birth	Mo. _____ Yr. _____ ☐ No Dr.	☐ Yes ☐ No ☐ No Dr.	_____ Days or ☐ None			1

Table II - HOSPITALIZATION DURING PAST 12 MONTHS

Were any operations performed on you during this stay in the hospital? If "Yes": (a) What was the operation? (b) Any other operation? (1)	What is the name and address of the hospital you were in? (Enter name, city or county, and State) (2)	Line Number
☐ Yes → ☐ No		1

FOOTNOTES AND COMMENTS

Card D

NATIONAL HEALTH SURVEY

Check List of Chronic Conditions

1. Asthma
2. Hay fever
3. Tuberculosis
4. Chronic bronchitis
5. Repeated attacks of sinus trouble
6. Rheumatic fever
7. Hardening of the arteries
8. High blood pressure
9. Heart trouble
10. Stroke
11. Trouble with varicose veins
12. Hemorrhoids or piles
13. Gallbladder or liver trouble
14. Stomach ulcer
15. Any other chronic stomach trouble
16. Kidney stones or other kidney trouble
17. Arthritis or rheumatism
18. Prostate trouble
19. Diabetes
20. Thyroid trouble or goiter
21. Epilepsy or convulsions of any kind
22. Mental or nervous trouble
23. Trouble with back or spine
24. Tumor or cancer
25. Chronic skin trouble
26. Hernia or rupture

Card E

NATIONAL HEALTH SURVEY

For: Workers and other persons except Housewives and Children

1. Cannot work at all at present
2. Can work but limited in amount or kind of work.
3. Can work but limited in kind or amount of outside activities.
4. Not limited in any of these ways.

Card F

NATIONAL HEALTH SURVEY

For: Children from 6 to 16 years old and others going to school

1. Cannot go to school at all at present time.
2. Can go to school but limited to certain types of schools or in school attendance.
3. Can go to school but limited in other activities.
4. Not limited in any of these ways.

Card G

NATIONAL HEALTH SURVEY

1. Confined to the house all the time, except in emergencies.
2. Can go outside but need the help of another person in getting around outside.
3. Can go outside alone but have trouble in getting around freely.
4. Not limited in any of these ways.

Card H

NATIONAL HEALTH SURVEY

Check List of Impairments

1. Deafness or serious trouble with hearing.
2. Serious trouble with seeing, even with glasses.
3. Condition present since birth, such as cleft palate or club foot.
4. Stammering or other trouble with speech
5. Missing fingers, hand, or arm
6. Missing toes, foot, or leg
7. Cerebral palsy
8. Paralysis of any kind.
9. Any permanent stiffness or deformity of the foot or leg, fingers, arm, or hand.

Card I

NATIONAL HEALTH SURVEY

For: Housewife

1. Cannot keep house at all at present.
2. Can keep house but limited in amount or kind of housework.
3. Can keep house but limited in outside activities.
4. Not limited in any of these ways.

Card J

NATIONAL HEALTH SURVEY

For: Children under 6 years old

1. Cannot take part at all in ordinary play with other children.
2. Can play with other children but limited in amount or kind of play.
3. Not limited in any of these ways.

Card K

NATIONAL HEALTH SURVEY

Family income during past 12 months

1. Under $500 (including loss)
2. $500 - $999
3. $1,000 - $1,999
4. $2,000 - $2,999
5. $3,000 - $3,999
6. $4,000 - $4,999
7. $5,000 - $6,999
8. $7,000 - $9,999
9. $10,000 and over

(Whereupon, at 12:05 p. m., a recess was taken, to reconvene at 10 a. m., Wednesday, August 7, 1957.)

AUTOMOBILE SEAT BELTS

WEDNESDAY, AUGUST 7, 1957

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON TRAFFIC SAFETY OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The special subcommittee met at 10 a. m., pursuant to recess, in room 1302, New House Office Building, Hon. Kenneth A. Roberts (chairman of the subcommittee) presiding.

Present: Representatives Roberts (presiding), Friedel, Rogers, Loser, and Schenck.

Mr. ROBERTS. The meeting will please come to order. The subcommittee will continue the hearings on seat belts. Through these hearings, the subcommittee hopes to assist the public in determining the true value of seat belts and as a safety device during accidents. Our first witness this morning will be Dr. R. Arnold Griswold, chairman, subcommittee on traffic injury prevention of the American College of Surgeons. I might say, Doctor, it is a pleasure seeing you again. I had the pleasure of seeing you before our subcommittee in Chicago, I believe, during the first week of August.

I realize you have come here at a very great sacrifice and we are taking you first so that you can get back. I understand you have some surgery to be performed after you get back, so you may proceed.

STATEMENT OF R. ARNOLD GRISWOLD, M. D., CHAIRMAN, SUBCOMMITTEE ON TRAFFIC INJURY PREVENTION, AMERICAN COLLEGE OF SURGEONS

Dr. GRISWOLD. In February 1955, a resolution of the committee on trauma of the American College of Surgeons, through the board of regents, was sent to the Motor Car Manufacturers of America.

This resolution recommended that they—

> stress occupant safety as a basic factor in automobile design, to include (1) doors which will not open on impact, (2) seats and cushions which will not become displaced on impact, (3) energy absorbing interiors, (4) adequate safety belts or other passenger stabilizing devices that will resist impacts of at least 20 G's.

Accumulated evidence in automobile injury prevention has in no way caused us to alter our opinions but, on the contrary, has strengthened them.

While our committee has done no definitive research of its own, it has kept itself informed of and has studied the work of the automotive crash injury research unit at Cornell, Dr. Horace Campbell of Denver, Colo., Col. John Stapp of the United States Air Force, the Ford

Motor Co., A. J. White of Motor Vehicle Research, the Indiana State police, the 1956 testimony before the House Subcommittee on Traffic Accidents, and others.

Careful study of these reports has confirmed the soundness of our recommendations of 1955. Particularly impressive have been the reports from Cornell and from Dr. Horace Campbell of actual highway crashes involving automobile occupants wearing seat belts, and the recent work of Colonel Stapp on the effectiveness and injury potential of seat belts.

Actual highway crashes are the only real proof of the soundness of engineering calculations or of staged experimental crashes in the development of protective devices. It is gratifying that most of the motorcar manufacturers, starting with the 1956 models, have made a start toward the development and application of devices to comply with our recommendations of 1955.

Some individuals, particularly A. J. White, have obtained wide publicity by objecting to seat belts. These objections do not seem valid to us at the present stage in the development of automobile passenger-restraining devices. It is apparently true that some belts and installations on the market are not up to standard and fail on impact.

This could be corrected by setting adequate standards by government or, preferably, industry action. The fear of being unable to get out of a burning or submerged car is exaggerated. Statistics of the Indiana State Police show that less than 1 percent of automotive deaths are due to drowning or fire. It is our opinion that an occupant protected by a seat belt would more likely be conscious and able to extricate himself from a burning or submerged vehicle than would an unprotected occupant who is likely to be unconscious.

The undoubted fact that in certain types of high-speed impact the safety belt might cause injury is, in our opinion, a very feeble objection when one considers that two-thirds of the deaths occur at speeds under 50 miles per hour, and that if an individual sustains injury from impact against a fabric belt, he certainly would have sustained much more severe injury from contact with unyielding metal and glass structures within the car, or objects outside the car, if no belt had been worn.

The Cornell figures have definitely shown the dangers of ejection, which obviously can be prevented by an adequate restraining apparatus.

Undoubtedly, more complicated and cumbersome devices would give a greater degree of protection, particularly at high speeds, than a well-engineered and well-installed lap belt. At the present time, however, from the standpoint of public acceptance and use of belts, it is best to make a compromise between maximum protection and optimum protection.

For instance, I know from personal experience in my own family and from others that many people will not use a shoulder strap restraint, particularly on short trips. When one realizes that, according to Indiana figures, 75 percent of the deaths occur within 25 miles of the victims' residence, it is evident that protection should be used on short as well as long trips. The simple lap belt is much more likely to be worn by the housewife on trips to the grocery and by the head

of the house on trips to and from work than is a more complicated device, and it does give adequate protection against the low-speed crashes which cause the majority of our deaths.

The greater number of nonfatal injuries, many of which result in permanent partial or total disability, are possibly more important both from a financial standpoint and the standpoint of suffering and disability than are the deaths. While it is very difficult to obtain satistical evidence regarding the reduction of severe injuries into the minor class by wearing belts, it is our opinion that the belt may be even more effective in this regard than it is in the prevention of fatal injury, since lesser forces are likely to apply in the nonfatal but severe injuries than in the fatal ones.

Mr. ROBERTS. Thank you very much, Dr. Griswold. How long have you been interested in this matter of automotive safety professionally?

Dr. GRISWOLD. From a professional standpoint since about 1932.

Mr. ROBERTS. And how long have you served on the committee on trauma of the American College of Surgeons?

Dr. GRISWOLD. Since 1942.

Mr. ROBERTS. How long have you been engaged in your profession, Doctor?

Dr. GRISWOLD. I graduated from medical school in 1925.

Mr. ROBERTS. And you have been active in practice since your internship?

Dr. GRISWOLD. Practice and teaching, yes, sir.

Mr. ROBERTS. And where are you located now?

Dr. GRISWOLD. Louisville, Ky.

Mr. ROBERTS. And what is your connection there in the medical profession?

Dr. GRISWOLD. I am in private practice of surgery and also a professor of surgery at the University of Louisville, School of Medicine.

Mr. ROBERTS. Doctor, I think that I express the feeling of this subcommittee when I say that we are highly appreciative of the great interest that has been shown in this matter of traffic safety by the medical profession, and especially on the part of the American College of Surgeons. I might say that your encouragement has had a great deal of effect and has been of a lot of help to this subcommittee as we go about our work, and I appreciate the appearance you make today and certainly thank you for your appearance last year in Chicago.

I notice that you directed your attention to a criticism that is made sometimes that people may be injured by seat belts when they would not have been had they not been wearing those seat belts. I call particular attention to that part of your statement at the bottom of page 2, the last paragraph, where you say:

> The undoubted fact that in certain types of high speed impact the safety belt might cause injury is, in our opinion, a very feeble objection when one considers that two-thirds of the deaths occur at speeds under 50 miles per hour, and that if an individual sustains injury from impact against a fabric belt, he certainly would have sustained much more severe injury from contact with unyielding metal and glass structures within the car, or objects outside the car if no belt had been worn.

I would like to know if you would care to make a comment on that particular phase of your statement, that is elaborate on that particular part a little bit more?

Dr. GRISWOLD. Mr. Roberts, I think it is rather self-evident that there would be a limit to human tolerance to impact against a fabric belt. The wider the belt, the better because it would spread the impact over more square inches, but there would obviously be a limit. Just what that limit would be, I don't think we know, and it would vary with different individuals as to their age, physical conditions, sex, et cetera, but at high speed impacts I think it is evident that there would be some injuries from belts. Bruises have been reported, et cetera, but it is our feeling that the belt would give protection even if causing injury against what would probably be a much more major injury if the belt were not worn.

Mr. ROBERTS. I take it that by your statement you would prefer a 3-inch belt or even wider in preference to the 2-inch width?

Dr. GRISWOLD. It would be better. Now as to the public acceptance of a 4-inch belt, I think we have another matter there, and these belts if installed in cars are absolutely worthless unless the public can be induced to wear them, unless they are convenient for the public to use.

Mr. ROBERTS. Yesterday I believe it was Mr. Haynes perhaps of Ford who stated that in his opinion even in a convertible or in an open-type car it would be preferable if the occupant were to wear a belt. How do you feel about that proposition?

Dr. GRISWOLD. I drive an open-type car myself, Mr. Roberts, and I wear a belt.

Mr. ROBERTS. You do wear a belt?

Dr. GRISWOLD. Yes, sir.

Mr. ROBERTS. I think that answers my question. Now I noted that in one particular part of your statement you have the feeling that there is a lack of proper standards as far as belts sold on the market today are concerned, and you say that you believe that some type of Government regulation or preferably industry regulation should be present in this field. I have introduced a bill which would provide that standards for seat belts, criteria rather, would be set out by the National Bureau of Standards. As you know, there is a very fine organization known as the Society of Automotive Engineers, and they have recommended certain standards in this field. However, as you know, a compliance with that is pretty much a voluntary proposition. It is my fear that the market will find and is finding some manufacturers who are putting out belts which in my opinion are not adequate and will not do the job.

Do you believe that we would acquire a better set of standards perhaps if the Federal Government promulgated some regulations, or would you still prefer the Society of Engineers?

Dr. GRISWOLD. Well, like most people I would prefer that industry do it voluntarily, but if they won't, then I think the Government should step in with standards such as they have for the aircraft industry.

Mr. ROBERTS. Thank you, Doctor. I certainly appreciate your appearance here today and your interest in this very important subject. Mr. Schenck?

Mr. SCHENCK. Thank you, Mr. Chairman. It is nice to see the doctor again here in Washington. Doctor, I think in some of our discussions in Chicago we discussed the injury that results from

so-called whip injury of the neck. Is it your feeling that shoulder harness would be a greater protection against such whip injury?

Dr. GRISWOLD. I don't think it would make any difference, Mr. Schenck. A whip injury occurs from an impact from the rear. It is when a car is stopped at a stoplight or something and someone hits them from the rear at high speed, the car moves forward, the car that is struck. The occupant's head stays stationary because of inertia and is whipped backward and then whipped forward. A shoulder harness would have no effect one way or the other. The shoulders would be held in a steady position by the shoulder harness and the head whips back and forth.

The best protection against that would be a seat back which would come up high enough to support the head, such as is true in airplane seats, and you will see it in racing cars and fighter aircraft.

Of course, that brings up another question and that is the visibility through the rear view mirror over such a seat.

Mr. SCHENCK. Yes; I was going to ask about that. So you feel that in addition to the difficulty of getting people to accept shoulder straps, in addition to rear vision difficulty that they would be of no particular benefit in these whip injuries.

Dr. GRISWOLD. In the whiplash injuries, that's right. It would be of benefit in preventing forward motion of the head and shoulders.

Mr. SCHENCK. Of perhaps helping out in the case of chest injuries.

Dr. GRISWOLD. Yes; chest injuries and head injuries in a different type of crash. The whiplash injury, I think, has been perhaps overemphasized. Actually it is more important from a legal standpoint than it is from an actual medical standpoint. Most of these patients that I have seen, most of them, not all of them—it is also true a great many of them are cured when they get their compensation check. My father used to call it greenback poultice. It is a great therapy for a whiplash injury.

Mr. SCHENCK. Then it is your feeling that restraint from a lap belt is sufficient at least at this time?

Dr. GRISWOLD. I think at this time in the public acceptance of belts. Now I wore shoulder straps for several years, not on open cars, but I took them out and put in lap belts because I found that the female members of the family would not wear them on short trips. They wear them on long trips but not on short trips.

Mr. SCHENCK. From your professional experience, Dr. Griswold, do you feel that lap belts are also helpful in preventing fatigue?

Dr. GRISWOLD. They certainly are, either lap belts or shoulder straps, but being securely fastened to the car, as it were, is a great factor in fatigue on long trips.

Mr. SCHENCK. Dr. Griswold, recently one of our newspapers editorialized on the danger of being speed drunk, I think they call it. They tried to draw an inference that people traveling at a certain or specified steady speed over a period of time became somewhat fatigued or less able to react quickly to road conditions, and I wonder if you have any comment on that—such as, for instance, does the seat belt promote or help that situation or should it be a question of variable positions in seat assembly itself? Do you have any comment on that?

Dr. GRISWOLD. The seat belt prevents ordinary fatigue or helps prevent it, and would be of assistance in that regard to people who get tired after driving for 10, 12, or 14 hours, which some people do, at a

stretch. I doubt very much if it would have anything to do with preventing the thing that you are speaking about, which someone has called highway hypnosis, which occurs on the turnpikes, particularly where there are long straight roads with no turns and nothing much to occupy the driver's mind. It occurs out west on the long, straight stretches. I have noticed it myself.

Mr. SCHENCK. Do you feel that seats which enable the driver to change his position forward or backward or up or down might alleviate some of that hypnosis?

Dr. GRISWOLD. Well, adjustable seats, of course, are necessary in order to put the driver in the most comfortable position in relation to his steering wheel and his accelerator and brakes. I prefer on long trips to drive in a fixed position which is the most comfortable. I don't change position in my seat. I think that is true of most people.

Mr. SCHENCK. I take it that it is your personal recommendation that automobiles ought to be equipped with lap belts.

Dr. GRISWOLD. At the present time, until some better device comes along. I think it is the best we have at the present time.

Mr. SCHENCK. Thank you very much.

Mr. ROBERTS. Mr. Friedel?

Mr. FRIEDEL. Doctor, I want to thank you for your very precise statement. I think I will direct my remarks to Mr. Roberts' bill requiring that the Bureau of Standards set up specifications for a seat belt or a lap belt. There is no question in my mind that the automobile industry would make belts of proper specifications, but we have a lot of sharp used-car dealers who are not connected with the automobile industry. We also know that there is indifference on the part of the public today as far as using lap belts or seat belts. But suppose it would catch on and the public would want the seat belts? Then you would see a lot of people coming out with seat belts with weak buckles, and so forth. They would try to get in the market and sell seat belts that would not meet minimum requirements. Don't you think that there should be some minimum requirements, some standard by which we could go before they are installed.

Dr. GRISWOLD. I would agree with that unless industry can do it through some such organization as the electrical people have done with the Underwriters' Laboratories, and so forth.

Mr. FRIEDEL. That wouldn't prevent anyone from selling cheap seat belts and advertising them at a lower price, unless it was done by an act that would require them to have a stamp that this meets United States minimum requirements.

Dr. GRISWOLD. That may be perfectly true. I wouldn't have any great objection.

Mr. FRIEDEL. There is no question in my mind that the industry itself is going to meet the minimum requirements and would probably go even further, but I can see some sharp practices if seat belts do catch on with the general public.

Dr. GRISWOLD. I wouldn't have any great objection to governmental standards on that. I would prefer to see it done by industry.

Mr. FRIEDEL. That is all. Thank you very much.

Mr. ROBERTS. Doctor, one other question and I am through. I notice in your statement that you state in the second paragraph of the first page that you have studied the work being done at Cornell,

Dr. Horace Campbell's work, Col. John Stapp's work, the Ford Motor Co., A. J. White, of Motor Vehicle Research, the Indiana State police, the testimony of 1956 before this House Subcommittee on Traffic Accidents. You mean that your committee as a whole has studied those various experiments?

Dr. GRISWOLD. Yes, sir.

Mr. ROBERTS. And studied that testimony and you have reached the conclusion after due consideration that you believe that the occupants wearing seat belts can reduce the injury-producing potential of accidents?

Dr. GRISWOLD. Yes, sir.

Mr. ROBERTS. Thank you very much. It has been a pleasure to have you before the subcommittee.

Dr. GRISWOLD. Thank you.

Mr. ROBERTS. Our next witness is Mr. Andrew J. White, director, Motor Vehicle Research, Inc., South Lee, N. H.

I might say in this hearing that we have tried to present all viewpoints and accepted any requests from persons pro and con on this question. Mr. White appears in opposition to use of seat belts and I want to thank him for his appearance here and for his contribution. He makes his contribution because of the fact that we want both viewpoints presented and we are glad to have you here, Mr. White. You may proceed with your testimony.

STATEMENT OF ANDREW J. WHITE, DIRECTOR, MOTOR VEHICLE RESEARCH, INC., SOUTH LEE, N. H.

Mr. WHITE. I am appreciative of the opportunity to appear before you here today to acquaint you with my work in the automotive safety field.

I think the best illustration would be to show some motion pictures in New Hampshire regarding seat belts first.

Mr. ROBERTS. You may proceed in any manner that you care to.

Mr. WHITE. First, I would like to point out that my activities have been under constant fire from many quarters due to the very nature of my findings and the scope of activities, most recent of which has been the field of restraining devices, a field in which I have taken direct exception to the published values and widespread publicity given to these devices for use in present-day automobiles.

I have been directly and indirectly accused of a great number of things, including working with certain car manufacturers to "sabotage" a competitor's sales program. A recent classic example of this came from an executive of a car manufacturer during a telephone call from Detroit.

I had advised each car manufacturer by letter and through their advertising agencies of a TV program sponsored by International Business Machines in which I would conduct a "live" crash or "roll over" accident in a 1957 car which we would modify to protect the driver. The point was to clearly demonstrate that safe design modification of automobiles was possible and should be demanded of the manufacturers of automobiles.

Each manufacturer was given an opportunity to submit his vehicle for this test. This was done to preclude any criticism of an individual selection favoring any particular make.

The results of advising each manufacturer were quite dynamic and included a temporary suspension of this program by the sponsor. This was brought about by pressure from the car manufacturers.

The executive of the car-manufacturing company advised me during a telephone conversation that my activities were seriously affecting his sales program and that he forbid the use of his product being used on such a program.

In spite of this, the program was completed as originally planned, using a new 1957 vehicle, purchased on the open market by the producer of the TV series.

At this point, we might as well clear up a question that will be asked sooner or later by this committee. That question will be along the lines of who sponsors Motor Vehicle Research, or where do the funds come from which enable the organization to function? In the interest of brevity, I would like to cover this phase in a succinct manner.

(1) Motor Vehicle Research was founded with my personal funds earned as an automotive manufacturer for 25 years until retirement.

(2) First sponsored by Science and Mechanics magazine to test every make of domestic and foreign automobile for performance and safety. This activity covered 4 years until terminated.

(3) Clients, including car manufacturers, engineering departments, and many others, have used and are using our services up to date with satisfactory results.

(4) The list of clients is numerous and includes many of our largest firms in the industry.

(5) Funds from research and design projects are funneled into safety research conducted on a strictly nonprofit basis.

(6) No executive of Motor Vehicle Research has ever received any remuneration for his efforts and time. These have been donated in the interest of safety.

I do hope this clears up the matter of sponsorship and the monetary aspect of my activities.

The next question might be, "Why automotive safety at no profit?"

Well, gentlemen, in this day and age we can still find individuals who will cheerfully give their time, money, and effort to some activities in an effort to do some good.

Unfortunately, too many individuals possess philosophy that does include the fact that you cannot take it with you and lack a spiritual understanding of the reasons why we are on this earth in the first place.

Why at this date in my life I pursue automotive safety is a question that you may be able to answer better than I can. What I do know, it is what interests me most even if the results of my findings are criticized. There is one fact abundantly clear, and that is, my integrity has never been honestly questioned, even though the results of my studies have not been welcomed by all.

The foregoing should clear up two points that inevitably present themselves whenever motor vehicle research is under discussion.

It is my understanding that the major points under consideration here today are crashworthiness of passenger cars and seat belts for use in these vehicles. I would like first briefly to present my findings regarding the former.

Whenever one is exposed to a discussion regarding unitized body versus separate body frame construction, he could hardly miss an

inference that each had been designed to afford passenger protection by certain phenomena or by a uniform progressive absorption of the kinetic energy of the vehicle via deformation.

The one important question that is never asked of the designers is whether or not the construction was actually designed to be of value in protecting car occupants in crashes?

An affirmative answer would be invalid because unitized construction has been a continental design for years and the frame body construction is merely a modification of the democratic buggy over the years.

The facts are, no consideration to crashworthiness has been given to the production automobile. In fact, it was never even considered in design.

What has happened is safety-minded individuals started to question construction and the manufacturers hastened to conduct tests to uncover some area that appeared to have merit. These areas were then publicized as a design feature.

No data have been given concerning any component's ability to work in unison with an adjacent component to absorb energy from a crashworthiness standpoint.

One important fact is outstanding: It is the total absence of any data regarding the energy absorption by elastic deformation. This is an important value not even mentioned, or in the majority of cases not even known to be present during a crash deceleration of an automobile.

The kinetic energy a vehicle possesses at any velocity is a value that can be determined by basic scientific and mathematical formula. This energy must be dissipated when a vehicle crashes and such dissipation is achieved in a number of ways, or combination of ways, including distance to stop, energy absorption of the impacted mediums by plastic and elastic deformation and distance moved, resistance to compression, and hosts of other factors that would require volumes to define and explore.

In summation in this area, my opinions based on actual test and field observations are as follows:

(1) Automobile designers take only incidental advantage or no advantage of the remarkable capabilities of certain areas of the human body to absorb impact energy in a crash deceleration.

(2) No valid data to support any deliberate design of crashworthiness of an automobile have come to my attention supported by published research or records compiled over a period of time.

(3) Our automobiles are designed for cost, style, performance, reasonable life expectancy, and others but not in anticipation that they will be involved in a crash and must protect the passengers from injury and death by scientific crash-worthiness design.

(4) Should these factors be acceptable to this committee and proven by impartial investigation, it might be well to forget the past and look to the future. The automobile industry possesses a great number of qualified and important engineers who can, with a "handsoff policy" create designs that will be acceptable to the public containing functional and crash-worthiness features that will reduce the injury and death-producing effects of crash decelerations on car occupants. I am sure these men would be willing and able to demonstrate the

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value of their ideas and creations by exposing their own lives and limbs in actual crashes. The benefits would be manifold and of inestimable value to the Nation.

One could refer to the automobile accident trauma as the Nation's No. 1 problem. This is a reasonable statement on the face of it but what happens in the future will have to be decided today. This is a case of what we can afford not to do.

Last year's figures for automobile deaths, injuries, and property damage speak for themselves. The three linked together provide overwhelming reason for out-of-the-ordinary effort and action.

The shortcomings of our present method of attacking the problem leaves us no alternative but the same action this Nation might take in case of war. We need to enlist the technical strength of our Nation to organize, correlate, and administer a really massive plan of action. Most of all, give the men and women who make up this strength the authority and the means to do the job to which they are called.

All the evidence points to the need for a move to straighten out the vicious spiral of "too little and too late." The issue is too big for politics; it calls for vision, enterprise, and courage, infused with real know-how.

If the authorities cannot find the people for the job now, then they should not hesitate to get the best opinions they can, regardless of race and station, but exercise care when any recommendations are made regarding any segment of the problem.

The crux of the problem lies in full support at once and not a pigeonhole.

The automotive safety field is overrun with so-called experts in every area with the basic qualified groups hesitant to step into the limelight in the face of the overwhelming odds of committees, politics and the large segment of an "advertising sensitive" press.

The unfortunate part of all this is the widespread acceptance by many of the ideas and opinions of the so-called experts, verified by the commercial segment of the industry when such verification enhances the balance sheet.

Summing up this section in brief, the following is applicable:

(*a*) What we require is an accelerated program in this field and complete deletion of commercialism from references to safety design by most persons so engaged.

(*b*) Unless we undertake a stepped-up program in this field and train future scientists at once, we will delay for generations the creation of protection for occupants of automobiles by means of design.

(*c*) Actually, the emphasis on power and the increased performance characteristics of our cars indicates in what direction engineering ability of the industry is pointed.

(*d*) Sadly enough, we have misdirected the talents of our engineers in the quest of sales. The results are a matter of record by the number of injuries and deaths due to automobile use.

(5) Up to this time, in my opinion, no program of this type has been undertaken with the primary goal to create a safe crash-proof protection to occupants as the first consideration, exclusive of all others. This is a must if the highway carnage is to be reduced and if necessary, legislation by our Congress should make it mandatory if the manufacturers do not undertake such a program at once. The crea-

tion of an agency supported by industry itself, independent and free from politics, should be set up to see that the program is carried out in an accelerated manner. Such an agency should be accountable to a congressional committee who would accept or reject the progress of the manufacturers.

Such a program would require time to be sure. I would set a time limit of 2 years for an acceptable vehicle that could be crashed realistically and provide protection to passengers. The reason for my suggestion of such action is summed up in the words of deFlorez, because the human equation has not changed and we cannot hope to change it in the foreseeable future.

We can through education, campaigns and other means modify the dire results of automobile use but the extent of this modification would not be sufficient. The human being must have protection in event of a mistake during automobile use if we are to achieve any worthwhile results.

The amazing progress of science and technology in our time, which had endowed mankind with virtually unlimited physical power, has brought with it a gigantic responsibility. Achievements, such as the mobile power of the internal combusion engine, the conquest of geographical barriers by the aeroplane, the boundless communications made possible by electronics, and now atomic fission with all its ramification has provided the means of performing miracles and producing catastrophes.

What man may do willfully with these vast powers remains to be seen. Whether he will benefit the world or destroy himself depends from now on more on his spiritual progress than his ability to create new engines.

Aside from the philosophic effect of man's scientific progress, which neither the scientist nor the engineers can foresee, there looms the prosaic danger of just plain mistakes that can misdirect his power or fail to apply it when needed.

The amplification of our physical power—which not only multiplies our useful effort by that but by the same token magnifies our mistakes in proportion—has not come without effort or without sacrifice of simplicity.

Up to the present, we have been able to keep up with technological progress by education and training. But we have now reached the point where the machine has dwarfed the man, for the characteristics of the individual—the human machine—have not changed in the memory of man and will not change for countless generations to come, while the manmade engine is capable of ever-increasing power, scope, and speed of operation.

We must, therefore, consider man's capabilities as a constant in contrast to the unending progression of the machine.

The human faculties of perception, action, reaction, and decision can now be taxed to such an extent that it is no longer possible to take full advantage of the machine unless the control of the machine can be tailored to human capabilities. The question—how do we do it?

Our machines must be manner by the average human being; their operation must be governed by his capabilities under the influence of mental stress, fatigue, and sudden change; consequently, the average man's capabilities must be analyzed, measured, and made available to the designer and engineer to make good our progress from now on.

Many critical studies of the average human being have been made. The subject is obviously a complex one which involves psychology, mechanics, and even spiritual forces of which we yet know little. These studies represent only a beginning, and a continuing and ever-expanding compilation of data which will provide the planner and designer with the probable characteristics of the average individuals who will man our machines of the future, which is absolutely necessary if survival is to be accomplished.

In my opinion, Mr. deFlorez covers the automotive picture quite well, and his conclusions point to a car designed to crash and protect the user.

At the very onset, I would like it clearly understood that, in my opinion, passenger packaging which would include restraint of a proven design is mandatory in providing protection to passengers of automobiles involved in crash decelerations. This must also include prevention of body-structure collapse. The theory is basic and supported by known physical facts and the laws of science.

However, such packaging and restraint must be part of the overall design in the vehicle and not an addition to a vehicle that has not even considered safe design or broad modification of design to protect passengers in event of an accident.

We have been exposed to data concerning tests to determine the injury potential of various components of automobiles, nearly all of which indicate to me progress in the field of crashworthiness of vehicles and safe design modification of various components to provide passenger protection.

Such data have been widely publicized by means of the press, radio, and television in such a manner that it has become almost universally accepted by some that progress has been nothing short of phenomenal.

The effects of the dissemination of such data are clearly outlined in the findings of Dr. Albert D. Freiberg of the Psychological Corporation of New York. The results of his survey, which was composed of personal interviews with 1,250 people, showed the following:

(1) Fifty percent of the public believed automobile safety has improved.

(2) Safety devices were given principal credit and these devices included safety belts, padded dashboards, padded sun visors, collapsible steering wheels, and better body and chassis construction.

(3) Chiefly blamed for less safety was too much speed and power, poorer materials, excessive length, and accidents with rear fins.

Be that as it may, this is the type of material that is appearing in the newspapers. It would be interesting to determine who sponsored this survey because it is, in my opinion, a repetition of the advertising of a car manufacturer. If the survey is accurate, the power of advertising, and so forth, is well proven. It is hardly likely that many of those interviewed were involved in accidents and could present conclusive evidence that the function of the praised components was the primary cause of injury prevention.

My examination of data, together with field studies of vehicles involved in accidents and actual tests under dynamic conditions, clearly indicates a condition of overselling the values of most of the so-called safe-design modifications undertaken to date.

The real danger of such publicity is that it may lead to the abandonment of investigation of safe design of automobiles or prevent the sorely needed accelerated research in this field.

The facts are, we are packaging our manufactured items, such as electronic equipment, and so forth, better than the passengers of our cars and trucks. The reasons are obvious due to research by our packaging engineers sponsored by the manufacturers of such items.

The manufacturers of such items could not tolerate breakage in transit of their goods because this would lead to the loss of customers and eventually their entire business. It would appear from one viewpoint that we place more value on our manufactured goods than we do on human life.

Packaging engineers conduct dynamic tests with their products under actual use conditions to prove their recommendations. To date, I am not aware of one advocator of seat belts or any engineer who has subjected himself to actual crash conditions in a standard automobile to prove his published findings.

It then appears to me that advocators are dogmatic about invalid conclusions. Until any engineer or advocator is willing to endanger his own life in actual crashes, he should be most hesitant to suggest that other human beings place their lives in his hands by following his recommendations.

It has been reported that previous experimental evidence supports the present belief that seat belts provide a high measure of protection to passengers in automobiles involved in crash decelerations of almost any magnitude.

Some researchers say that experimental evaluations of potential protective gains are questionable and inconclusive because the equipment and methods used do not provide sufficient accuracy in the determination of the many variables found in automobile accidents.

My research in the field of restraining devices, a large part of which involved automobile seat belts, clearly shows a very limited value for seat belts when used in the present vehicle interior designs. Proof that I personally believe in the previous statement is perhaps most evident by the fact that none of the automobiles I own have, or ever had, such equipment installed. And no man in our organization, test driver or otherwise, has had a seat belt. Obviously what I have seen myself at least convinces me that these are a dubious panacea. This is further proven by crash tests in which I rode wearing a seat belt abandoned in favor of a military harness in order to survive.

Our studies indicate that the value of seat belts can be summed up as follows:

> If it is possible to select the type of accident you are going to be involved in, wear a seat belt; if not, do not wear one as it may be the cause of death or serious injury.

Some studies indicated that seat belts have a limited ability to protect occupants in crash decelerations of certain magnitudes and impact angles. There is a substantial amount of evidence that clearly defines the protective qualities of seat belts even though these qualities are limited and are operative only under certain conditions. Some data show the inherent lack of protection and injury-producing qualities of seat belts in some circumstances.

Somewhere in between lies the answer to the true value of seat belts as safety devices.

I would like at this time to show a series of pictures taken, a short documentary of 8 years of research in the field of restraining devices and crashworthiness of automobiles.

(At this point a movie was shown.)

Mr. WHITE. This is a 1957 vehicle driven by a test driver with modification, three end-over-end rolls, no injuries.

This is a crash deceleration on the IBM show we show about when we first started to read the paper, seat belt on a dummy in the rear. This is a retake of the 1957 vehicle rolling. This is 35 miles an hour, semifixed object, dummy seat belts.

This is slow motion, approximately 5 times normal projection, to show the tremendous amount of energy that an automobile at 35 miles an hour possesses. It can pick a bus off the ground, spin it, the seat belt broke, standard, specified on the dummy used in this test.

Mr. FRIEDEL. Is the dummy equipped with seat belts?

Mr. WHITE. Equipped rear with missile camera to study. This was a dummy rear.

These are some of the early tests involving automobiles of years 1935 to 1940, studying what would happen to doors if we roll them over, impacted them from various angles. These are the first tests conducted at Portsmouth to study the vertical component given to a vehicle and passenger impact in a semifixed object such as a bus at speeds to 65 miles an hour.

We find no vertical component in a fixed object or semifixed object crash unless the speed reaches this magnitude of approximately 50 miles or so an hour, or over 25 miles an hour; sorry.

This is the first Kaiser, which was advertised at the time as the safest seat in any American automobile. This was conducted at the request of Mr. Kaiser, who deleted this advertising after this test.

Peculiarly enough, in these older model cars of the composite-body type we were unable to open our doors in impacts at certain angles of certain speeds.

Mr. FRIEDEL. Will you explain to us what you planned to determine by these crashes?

Mr. WHITE. We are jumping from one series of tests to the other. In this particular test here we are trying to determine what force acts on the automobile to open the door in a collision of a static automobile versus an impact by a dynamic automobile with passengers. We have used, in these particular tests, dummies; they are not anthropomorphic; they are simply store dummies.

Mr. FRIEDEL. What are you trying to say?

Mr. WHITE. This is simply an investigation of all models to determine why doors open.

Mr. FRIEDEL. Are you trying to show that the modern door locks being used are not a safety factor?

Mr. WHITE. Not here, sir, because these tests were taken some 5 years ago. The tests that you are now seeing go back about 5 years. We haven't come to the modern door as yet.

Mr. FRIEDEL. Are you favoring the modern door locks or opposing the modern door locks as a safety factor?

Mr. WHITE. The number of samples that we have are not sufficient to give us or allow us to be conclusive in regard to the effectiveness of present door locks. We do have some cases where the door locks

failed in conditions we feel they should not have failed if they were safety locks.

Mr. FRIEDEL. I have observed that these safety locks are a great improvement. I cannot speak for the other members of the committee.

Mr. WHITE. We don't have a conclusion in this respect as to the modern automobile on door locks. There has been a great deal of controversy regarding steering wheels. This study was conducted for the only manufacturer of steering wheels of any size in the country. This was the original study conducted at the University of New Hampshire regarding the effectiveness of a particular design of steering wheels. The differentials we found between these deep-dish type of wheels, a copy of the study which we will leave here, was not sufficient to call it a safety wheel. We did not test the Ford safety wheel as advertised. This is a high-speed picture of an abnormal area simulated striking a Ford wheel. We recommended to the manufacturer the removal of all horn rings of the nature because we had ample evidence in prior years that these horn rings lacerate the head as it has a rotational effect into the steering wheel. We have been advised by the manufacturer that we will have a plastic wheel that will yield within the limits of tolerance of the human head and fold under without fracturing and tearing the face. We feel that this is a very definite step forward.

Mr. FRIEDEL. Are you trying to say that there has not been an improvement on the steering wheel as a safety factor?

Mr. WHITE. When we refer to the deep-dish steering wheel we refer to the deep dish used by Chrysler in 1954 versus 1955. We find no significant difference in this type of study of these wheels. We have not tested the 1956 or 1957. This is a study done at the Bureau of Public Roads to create a crash barrier that would cost very small sums of money in the median scripts.

We have proved conclusively and the Bureau of Public Roads as this record that you can create a barrier in the center of a median strip of highway, that you can crash it 50 miles an hour without scratching the paint on the car or without injuring the occupant. This is a matter of record. This was our original research in this field of multiflora rose japonica, as we call it.

Mr. FRIEDEL. Do you use any safety belts in any of these tests?

Mr. WHITE. We do.

Mr. FRIEDEL. Are they of any help or not?

Mr. WHITE. We do, in certain types of accidents, we find they are perhaps mandatory, and we will show you how we do it with our live drivers.

This is a high-speed picture taken at 3,000 frames a second of the crash barriers in the center of our highways. We understand that Illinois has planted 11 miles, Connecticut has planted 14. I think our costs involved here ran into some $50,000 before acceptance, but nature provides the perfect barrier in certain climates if we will accept it and plant it. We rode these live at 55 miles an hour, G force averaging 9. No problem. Yet we wore a standard harness and belt assembly in a specially designed Ford automobile. The seat interior was entirely taken out. Polystyrene foam cockpit was included. Here is a crash with a seat belt with a dummy. We will see several views of this particular crash, speed 18.1 miles per hour. Now, everything

that happens in these crashes is too fast to really see exactly what occurs to the dummy, so we are going to show you a 9,000-frame-per-second picture of this dummy.

The entire phenomena took 82 milliseconds, and in this time it is important to note that the dummy with the standard seat belt went through 1½ cycles of motion to strike the dashboard, return to the seat, go into the back seat, return to the seat, and go forward and then return to the seat. And in the 30 other tests with and without dummies and with live drivers, we find the same condition exists using a seat belt. Penetration of the windshield is quite pronounced.

Mr. FRIEDEL. Have you ever seen these tests on proving grounds?

Mr. WHITE. We have seen several motion pictures of them.

Mr. FRIEDEL. Have you ever noticed pictures in slow motion where tests have been made with and without seat belts?

Mr. WHITE. We have seen a great many of them and we cannot say for fixed object crash that the seat belt should be worn.

I think this is better emphasized by our drivers refusing to wear them and always coming out. In a rollover type of accident our drivers will wear a belt and demand them.

This is at 9,000 frames, the belt held, no problem existing with anchorage breakage. The jackknife effect without the 40 inches of unobstructed area in front of you, you are bound to have the head strike the top of the dash. Then we find a severe whiplash condition under these circumstances in we will say approximately 25 of 30 tests at speed of approximately 7 miles per hour into fixed objects up to speeds of 35 miles per hour.

The elongation factor under dynamic conditions of certain types of webbing should be included in any specifications for restraint. I have failed to see it in the SAE.

I have failed to see the matter really mentioned but there is an elongation factor, especially when a belt is exposed to high temperatures of the sun laying on the seat of an automobile.

As a speed of 18.1 miles per hour——

Mr. FRIEDEL. Did you take the same test without a seat belt?

Mr. WHITE. We did, sir. We will show you this. And the distribution of the forces was over a large part of the chest area with some penetration of the face. You will notice that he is almost horizontal. He weighs 165 pounds. He is fully anthropomorphic and anthropometric. This is what happens in each case in our tests to the body. We cannot predict the kinemetic behavior of the body in all crashes because a change of 2 to 5 degrees of the angle changes the entire action of the dummy. Bear in mind that 81 milliseconds is a very short interval of time, and this is the time it took.

There is no coefficient of restitution involved in the vehicle to any degree. We find no consideration of this in a fixed-object crash under 25 miles per hour. The main objection to the use of a seat belt in a crash of this type is that it does not protect the head, and I think everybody is in agreement and the Congressional Record points out that the head is the most vulnerable part of the body and is the one that receives most injuries.

This is a picture documentary done with the United States Air Force.

(Discussion off the record.)

Mr. FRIEDEL. Mr. White, we have another witness and we will have to adjourn a few minutes before 12. I had a lot of questions to ask but time is running out.

Mr. WHITE. Considering the dynamic effects of impact forces when applied to a complex elastic system such as the human body, all test devices, including anthropometric and anthropomorphic dummies, have value, but such value is limited in research fields dealing with these restraining devices.

Dummies serve as a guide for the time motion histories of a mass during a deceleration but fail to respond to dynamic forces in the same manner as the human body.

Most studies of seat belts and harnesses employing simulated human bodies cannot be considered wholly valid when the human body is basically what is under study.

The differentials found in the interior environment of present-day automobiles might cause some investigators to report a seat-belt installation the primary reason for passenger protection, when some other factor contributed a larger percentage of this protection in combination with the seat belt.

Differentials in impact angles of the same vehicle can confuse investigators and might lead to the abandonment of restraining devices now under consideration or to the limited use of them in the future.

Present data indicate the limited value of seat belts and should be given consideration.

This limited work is intended to show the variables encountered in automobile accident investigation and may assist in pointing out features generally overlooked when seat belts are evaluated at accident scenes. It is a well-known fact that the rapid and ungoverned dissipation of the vast amount of kinetic energy a vehicle possesses at high speed usually results in extensive structural deformation and death and serious injury to occupants of the vehicle in a crash deceleration.

Preventing the collapse of the structure surrounding car occupants and restraining them from contacting the surrounding structure is a direct method of reducing the highway toll of human life. Structural collapse includes the prevention of doors opening in all types of accidents. We must remember that large factors of safety are basic principles of engineering and can be built into our automobiles.

However, considering the present-day structure, to strap a man in and hold him for this structure to impact him under deformation conditions is reducing his chances of possible survival.

The design and the installation of restraining devices such as seat belts, require consideration of the many force angle factors included in a crash deceleration. It is highly improbable that any one make of vehicle will impact objects in the same manner during a series of accidents. To a large degree, the contact area of the impacted object will control the forces acting on the vehicle occupants.

Our studies clearly show that the determination of the preimpact velocity of a vehicle by means of evaluating deformation is an impossible task. Our tests clearly show that sheer fallacy of attempting to determine the preimpact of or impact velocity of a vehicle by means of structural deformation.

Bear in mind, forces are also controlled by time-distance relationship and sheet metal deformation factors included in the deceleration.

When we speak of sheet metal deformation, we must realize that an extremely small amount of energy is dissipated by this phenomenon.

Consideration must be given to the preimpact position of the occupants, together with the crash awareness tension or bracing of these occupants.

It is known, also, that the forces acting on occupants of vehicles involved in fixed object head-on types of crashes will be higher than those found in a two-vehicle crash. This is due to the fact that when two vehicles collide, one or both vehicles usually come to rest some distance from the initial point. This distance (decelerated) tends to reduce forces acting on the occupant because the kinetic energy of vehicles is dissipated over a longer period of time and over a greater distance.

However, especially in multivehicular accidents of this type, occupants are sometimes subjected to radical changes in direction during the deceleration time because some peak force intervals were acting upon them in many planes.

It is obvious, therefore, that restraining devices should be designed to cope with these variable forces within the limits of tolerance of normal and even subnormal car occupants.

The severity of injury in automobile accidents is rarely in direct ratio to the crash force. When vehicular body structure remains substantially intact, crash injuries are principally the result of the individuals being thrown against objects inside the compartment.

Wide variations in the extent and the severity of injury among several people who have been in the same crash are not uncommon. Variations are often due to the "injury potentials" (of interior design) of the objects which each person struck rather than force of the crash.

It is in that respect difficult to predict kinematic behavior of passengers during a fixed object crash; it is dependent upon many factors; angle of vehicle contact; area of impacted object; applications of brakes prior to impact; and others.

Front seat passengers wearing seat belts will receive the energy of a rear seat passenger's weight in a two-door sedan, less frictional forces of the rear passenger, in a crash deceleration.

This force is sufficient to increase the head blow to the front seat passenger on the dash top and face. This often causes denting of the metal area contacted. An additional abdominal load is given to the front seat passenger at the best area. We must also consider the jackknife action of a front seat passenger with a seat belt and such action would cause a pressure point on the abdominal area of our present-day design of buckles on seat belts.

We have been exposed to data that indicate that the passengers are acted upon by a vertical component of a crash causing them to continue forward and upward.

Some of these data indicate that such a condition exists even at low speeds. Our tests under actual dynamic conditions using standard automobiles indicates that this vertical component is not present at speeds below 25 miles per hour. We find that the occupant continues forward in an almost horizontal plane.

It is unfortunate that the excerpt from the Air Force Technical Report 5915, part II, December 1951, by John Paul Stapp, lieutenant

colonel, Medical Corps, USAF, has not been given sufficient consideration.

He states that in actual practice, the occupant of a car is seldom given 40 inches of unobstructed forward clearance in which to jackknife his body; the angle of application of force may pull him partly or completely out from underneath a seat belt or impinge his lower abdomen along one edge or a double V of the webbing, or the belt may catch under the margins of the ribs across the upper abdomen.

The effect of 100 or 200 pounds per square inch in shear on these soft tissues and the organs underneath is almost certain to rupture and tear. When less than 40 inches of unobstructed area is afforded the front-seat passenger wearing a seat belt, we can expect a high incidence of fatal and nonfatal head injuries. There are numerous statistical studies that disclose the high incidence of fatal and nonfatal head injuries in automobile collisions and accidents.

Medical data indicate that the dynamic energy input required to cause head fracture is much lower than the energy requirement of a static load to cause a similar fracture.

No significant data has come to light disclosing the contribution to a death or mental complications which may result from a head blow received in an automobile accident many years before.

However, in the field of boxing there is ample evidence of the postaccident complications that can occur when a blow or repeated blows to the head have been received. Since 1900 over 300 men have died from injuries incurred in the ring. No count of those who died months and years before they were buried is available. An article in the Journal of the American Medical Association by Dr. Frank Ferlaino, shows the need for boxers' gloves so designed as to afford the hand less protection and the head more.

In this respect, the same consideration is needed in designing the automobile dashboard top and face and other surrounding structures that might be impacted by the head during a crash. This is imperative because seat belts will not restrain the upper torso in most crashes.

Brain wave tracings by Dr. Harry A. Kaplan and Dr. Jefferson Brouda summarized in the Journal of the American Medical Association showed that only a few of the 1,000 boxers examined directly after a fight had the type of brain wave that might be termed classic.

We must bear in mind that some human heads are more vulnerable to blows than others. Usually this is traced to the center frontal bone shielding the brain behind the forehead. The majority of solid blows to the head are apt to cause minute hemorrhages on the brain surface. It may take years for the effects of such hemorrhages to reveal themselves.

Damage to the brain through hemorrhages or otherwise is irreparable.

Unlike other parts of the body, the brain cannot repair itself. It is probable that no head blow is taken with impunity. Unconsciousness from a head blow usually results in irreparable brain damage.

Since protection for the head cannot be provided by seat belts, internal structure design and proper restraint for the upper torso seems to be the logical approach. Injury to most other parts of the body, while crippling and disabling, have largely been circumvented by modern technology.

Almost any damage to the body can be repaired by surgery, but damage to the brain cannot be repaired. Because head blows dominate the list in automobile accident injuries, it is well to consider the limited ineffectiveness of seat belts as a protective measure to this section of the body.

Therefore, it can reasonably be concluded from statistics that head injuries predominate in most cases of death or injury to occupants of automobiles involved in crash decelerations.

Restraining the lower body by means of a seat belt alone will not reduce the head injuries materially if the surrounding structures are within range of the head during a crash.

High pressure structural points would also increase the injury exposure materially. Disregarding the crash worthiness of the car body structure surrounding the occupants, which of course should be a primary consideration, we must view the internal environment as the immediate source of injury potential.

It is this source that should receive consideration when seat belts are involved because of their interrelationship. Why restrain the lower body section when the head is most vulnerable to impact?

To restrain the lower body and allow the head to impact a knob or dash contour or windshield that will cause a localized high pressure force to be transmitted to a body section so sensitive to injury seems to defeat the purpose of a seat belt.

Moderation of the mechanical causes of head injury is so closely related to seat belt protection that it cannot be ignored. In some accident cases, it might well be proved that a seat belt was the cause of death or injury. For example, a fixed-object crash occurs at a relatively low speed.

The passenger's body is restrained with a seat belt that functions properly within the limits of the forces involved. The upper part of the passenger's body jackknifes and his head strikes a narrow dash contour or a knob with a force sufficient to cause an undetected brain hemorrhage.

He dies a month or a year later, although no damage was evident at the time of the accident. This injury condition may occur also were the head to strike a crash pad designed for protection at low-velocity impacts. In the same crash without a seat belt, this passenger might have impacted the same area or some other area with another part of his body less vulnerable to injury, or the force might have been distributed over a greater body area that would materially reduce the injury potential.

The seat belt, therefore, could be the direct cause of death or serious injury. The obvious answer is not this kind of restraint in the present-day automobile.

Our studies indicate clearly that the modern automobile in a crash deceleration into a fixed object will not provide a passenger with any protection at impact speeds even as low as 13 miles per hour. These studies show clearly that the frontal area and structure composed of the grill, the fenders, and the bumpers, et cetera, absorb a minimum of the kinetic energy available when a car is decelerated by means of contact with a fixed object.

Moreover, our studies clearly support prior studies in this particular area. While it is true that the sheet metal, grill area, et cetera, of the

modern automobile absorb some energy, the percentage that it absorbs is negligible in protecting the passenger of the vehicle.

The immediate danger to fliers from rapid deceleration resulted in the development of an effective restraining harness. This harness consists basically of straps that hold the body firmly in the seat, controlling both the upper shoulder and lower pelvis portions of the body.

Previously a simple lap strap was used, but this offered some protection in low-speed crashes only and was found to be useless, if not dangerous, in high-speed crashes because it permitted the spine to flex forward and allowed the head to strike the cockpit "jackknifing." Moreover, the snubbing action of a seat belt in very violent crashes may compress the soft organs of the abdomen, such as the liver and the spleen, which in certain circumstances could amount to rupture or pulping.

While our experiments have not covered the medical aspects of the injury potential of the seat belt, they have shown clearly that such a device has extremely limited protective qualities.

Our experiments with particular restraining devices being adapted to the present seat configurations have proved to be unsatisfactory. We may say that a satisfactory harness has been designed, but though the harness withstood the force of the deceleration, either the seat itself broke up or its fastenings to the floor became detached. Thus we found it necessary to stress both the seat and the attachments to restrain forces at least equal to those which the harness was designed to meet.

It was observed through a study of ultra-high-speed motion pictures that the present day harness, even though anchored to the floor, depended upon the rigidity of the seat back in order to provide the wearer with some measure of protection.

Most harness assemblies installed in the modern automobile are anchored to the floor, pan or frame areas directly behind the back of the front seat. The shoulder harness is secured to this anchorage point and continues vertically to the top of the seat, then over the shoulder of the occupant and in back, down to the anchorage point. Should the back of the seat be stressed beyond its resistance qualities, this webbing line attempts to assume a straight line between the anchorage point and the contact point on the top of the seat back or the shoulder of the occupant. When the seat back fails, the distance between the dash and the windshield area of the vehicle and the occupant becomes shorter and in most cases allows the occupant to contact these particular sections of the automobile.

It is apparent then from our studies that the adoption of any present day harness or seat belt has many limitations. Our current data indicate that adapting a simple lap strap in the present day automobile has extremely limited value.

I feel the seat belt cannot be recommended since it offers little or no protection to the head although it has been stated that the belt will reduce the amount of energy absorbed by the head. The differential in energy input to the head of a restrained and unrestrained passenger seems to be now in the order or reducing the use of a .38 caliber pistol to a .32 caliber in order to render an opponent ineffective.

On an ocean liner it is required by law that each passenger be provided with a regulation lifejacket. These lifejackets show a distinct uniformity of appearance and usually are jackets that have proved their worth.

It is with considerable wonder that a casual shopper sees a variety of seat belts and harnesses on sale in various shops at prices ranging from approximately $3 to $25 and all carrying claims of excellence in well-worn sale phrases. The analogy between lifejackets and seat belts should be very close. Both are designed specifically to save life. However in practice the analogy breaks down completely for the former are demanded by law and are proved after testing while serious doubts have been raised as to the efficiency of the latter which do not have to meet practical or official specifications as to design or the materials used in their construction.

Modification of this statement is in order in view of the SAE specification for seat belts that has recently come into being. However, these specifications do not include the control of elongation of certain types of webbing used in our standard seat belts. This elongation factor is extremely important in restraining devices.

A restraining device is, or should be, a scientifically designed article produced with the clearest concepts in mind of what it has to do and how it is to do it.

Consideration should be given to its particular adaptation to particular vehicles. Unfortunately judging from the multitude of materials and even the basic designs of restraining devices that are offered, it is abundantly clear that these concepts have neither been understood nor investigated, and so far as officials are concerned no practical law exists to insure that even the minimum of safety is provided by a seat belt.

Therefore it is not surprising that the public buys according to its pocketbook, in sartorial fancy, acquiring all too often no more than an illusional protection, facts about which coroners recently have made pungent remarks when investigating fatalities on the road. This position then is rendered more tragic when it is remembered that the dead motorist bought this restraining device with the express idea of protecting himself from such a fate.

Manufacturers have been explicit in their literature concerning restraining devices for children and others, stating that these devices will provide protection and prevent injury even under most severe crashes. Such sales claims influencing public thinking are certainly a clear indication that the commercial aspects of human safety are more important than the basic concepts of it. How can we, then, openly endorse present day restraining devices and even predict that these devices have protective qualities when the human tolerance to forces produced by crash decelerations are practically unknown?

There also have been numerous studies that indicate that prevention of ejection during crash decelerations of car occupants have reduced the number killed and injured each year. These studies are not valid in view of the fact that no data concerning the condition of the occupant of the vehicle are available immediately prior to the ejection.

Our studies show that in a head-on type of crash, the passenger continues forward, impacting the windshield or dash area prior to ejection. It is not worth considering whether this particular passenger was injured critically or fatally prior to the ejection or whether the primary impact was a positive factor in death or injury and not contact with some external environment?

We have conducted a series of fixed object crash deceleration tests at impact velocities of 13.1, 14.3, 14.7, 15.4, 17.9, and 18.1 miles per hour using anthropometric and anthropomorphic dummies fully articulated and weighing 165 pounds.

These tests have provided valid data regarding the kinematic behavior of front seat passengers wearing commercial seat belts. A study of a motion picture record of these tests recorded on 16 millimeter film exposed up to 9,000 frames per second revealed interesting data concerning the time-motion histories of the dummies and showed clearly that the front end structures absorbed a negligible amount of energy by deformation.

These studies have shown the following:

1. Front end structure deformation absorbs a negligible amount of energy.

2. Elastic deformation is more effective in absorbing energy than plastic deformation.

3. Jack-knife action of passengers restrained with seat belts during a fixed object crash at 13.1 miles per hour exposed the face and head to violent deceleration by contact with the windshield and then caroming off to the dashboard top.

This condition existed even under an average deceleration of less than 6 G and does not consider several peak decelerations that occurred during the entire phenomenon. The average human cannot brace against more than 2 G force during a crash deceleration.

4. The vertical components given to passengers in a fixed object crash at 13.1 miles per hour are of a negligible nature and do not control the direction in which the passenger travels during a crash of this type at this velocity.

5. The restitution coefficient of the vehicle at 13.1 miles per hour impact was too small to have meaning.

6. Tests at somewhat higher impact speeds revealed factors not found at 13.1 miles per hour. The vertical components given to passengers were of a magnitude to control the direction of the passenger to a large degree and the restitution coefficient was of a nature that warranted consideration.

7. Tests at 16.2 miles per hour (preimpact velocity) using a standard nylon seat belt anchored to the frame of the vehicle and positioned across the lap area of the passenger at an angle of approximately 45° showed that seat belts were ineffective in restraining the upper torso of the passenger. During the deceleration, the passenger remained in his preimpact position for 18 milliseconds, while the front end of the vehicle deformed. The velocity of the vehicle in the seat area did not diminish until the front end deformation was almost complete and the nonyielding vehicle component of the mass was stressed. The passenger imposed a load on the seat belt that caused elongation of the webbing that reached an estimated 8 inches at one point in the deceleration.

The head of the passenger penetrated the windshield approximately 7 inches. The elastic deformation of the windshield was considerable, yet the standard aluminum helmet was scarred and dented.

Knee-dash contact was present and the head caromed to the dash even denting it approximately seven-eighths of an inch over a wide area. These actions were followed by a vertical rise of the pas-

senger's entire body approximately 11 inches from the top of the seat squab until the body was almost horizontal with the head near the center of the rear compartment area above the seat back top.

This action was followed by a one-half cycle of the first action before the passenger came to rest in relatively the same seating position he occupied before the impact.

Our studies clearly indicate a need for further investigation of seat belts before any valid conclusions can be reached regarding their usefulness.

Our field investigations of actual accidents now indicate that a large number of both passengers and drivers survived because of ejection from vehicles. This is in direct conflict with some studies that tend to question the validity of some subjective data used in those studies. In a number of accidents, the passengers and the drivers were ejected and survived while those remaining in the vehicle received fatal injuries.

Conversely some people who were ejected died but we were unable to determine whether or not they received fatal injuries prior to ejection or by contact with some external environment.

The problem is one of obtaining an abundance of valid data and I repeat valid before a conclusion can be reached. In the meantime it would be most desirable to delete publication of questionable data and the advocation of seat belts in the absence of data that cannot be challenged.

Some of our studies of passenger behavior during fixed object crashes at low-impact velocities revealed interesting data and led us to the conclusion that preimpact seating position of vehicle occupants, the angle of attack of the declerated vehicle, crash awareness tension of the passenger and the impact velocity of the vehicle control the kinematic behavior of such occupants.

Prediction of this behavior, even under controlled condition, is not possible when a slight change in one condition occurs. This change affects all of the conditions to varying degrees and it is impossible to predict the effect of these changes.

Our investigation included the mounting of high-speed missile cameras on the framework attached to the rear section of the various automobiles. This camera recorded the action of occupants wearing seat belts during fixed object crashes and collisions with other vehicles and trucks. No two-time motion-picture histories could even approach uniformity and in fact, the differences were so widespread that no prediction of passenger behavior could be made even if the angle of attack, preimpact seating position and many other factors were almost identical.

This tends to support my theory that accident analysis studies reported are defective to some degree.

The most important considerations concerning seat belts used in automobiles are the data regarding these safety devices be valid and capable of withstanding investigation by further research. Until such data are at hand, all research groups should refrain from advocating such devices for use in present-day automobiles.

Important, also, is whether seat belts were actually fastened in all accidents in which the belts were praised for saving lives. I would suggest in cases where seat belts were involved and such cases are

sued for statistical data, removal of the belts should be undertaken and laboratory examinations made to disclose whether or not fractures of any of the thousands of small fibers that make up the webbing were present. This would conclude whether or not seat belts were used during the particular accident reported.

In summation, it might be well to consider the following before advocation of certain devices becomes so widespread. We must be ultraconservative in our opinions regarding safety devices because we are dealing with human lives.

(1) Advocators of safety devices should be required to prove the value of such devices by submitting themselves to the conditions under which they claim such devices to be operative. Lack of willingness on their part is a clear indication of doubt, defective data, or possible commercial affiliation.

(2) In the area of seat belts, consideration of the possible increased exposure to whiplash injuries should be investigated thoroughly. This type of injury is most severe. Holding the body with a seat belt and allowing the head to accelerate seems to defeat the purpose of protective restraint. The mechanism of the occurrence is not too difficult to understand and will be illustrated in the motion pictures to be shown here. The close relationship between seat belts and modern car seats should receive investigation.

You will note in the research film a tourniquet action on the waist of the dummy when the seat back failed. After all, the seat is between the anchorage point of the belt and wearer. Seats weigh up to 90 pounds and some anchor points are violated with forces as low as 3 G.

(3) Reporting by means of statistical data that seat belts have extreme value suffers serious defects when the following points are used as controls:

(a) Estimation of vehicle preimpact velocities by means of investigation methods, that is, tire-mark measurements, deformation, and other physical evidence. The problem is so complex that estimation of vehicle velocity even by means of on-the-spot visual observation is hopelessly inadequate. We have made studies in both areas with several hundred people and the results bordered on the ridiculous. We must explore the validity of the controls before we use the data for conclusions.

(b) Compilation of data regarding survival by means of ejection before offering conclusions supporting nonejection. Many people walk away from a crash because they were ejected while those who remained with the vehicle were lost.

(4) Use the true index of the accident trauma. The number 40,000 died in 1956, is numerically small considering 2,368,000 injuries occurred. The true index is the number of injuries and these have been increasing at the rate of approximately 100,000 per year since 1936.

(5) Create a central bureau for information and prevent personal and agency disputes regarding safety from publication for popular consumption.

(6) Take the baling wire and pliers away from qualified and sincere research men and provide them with the best research tools the Nation can produce. I am sure these men will come up with the answers at a cost less than what we spend to clear water lilies from

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our waterways. After all, the over 1 million dead is grim evidence of the dire need for basic research.

(7) Place the responsibility for the injuries and deaths of users on the manufacturers of our automobiles unless they can present valid evidence that their products are built with all-out consideration that those who use them are human and will have accidents. It would be indeed refreshing to read advertising or view a television commercial that stated without reservation that you can crash in the new X car and survive without injury or death at a speed of 20 miles per hour.

Also, adding that such was proved by the designers who exposed themselves to the stated crash condition to test the design. From 20 miles per hour we could progress to 25 and so on as research progresses.

(8) If we have been able to harness the atom and produce synthetic rubber in a relatively short period of time, I am sure the crash-worthiness design of a vehicle is a relatively simple matter.

(9) Should my statements act like seeds on stony ground then drive your own car into a fixed object at 20 miles per hour with your family and review the results if you survive. The responsibility of men in the safety field is gigantic and these men should exercise care because they may be killing and injuring human beings by their untested opinions.

The accident problem is one that may not yield readily to wholesale solution but may have to be solved by each individual.

However, the human race still has wars, criminals, hate, greed, and many other faults which centuries of time and laws have not cured. The human must be protected from himself when an automobile is involved.

One means is to build a vehicle that gives him protection when he makes a mistake. To date this has not been done or we would not be here today discussing the problem.

Mr. FRIEDEL. Were these pictures taken with the consent of the Air Force at Portsmouth?

Mr. WHITE. They were, sir and at Offutt Air Force Base at Nebraska.

Mr. FRIEDEL. Was the commentary made by the Air Force?

Mr. WHITE. The commentary is cleared by the Air Force here in Washington who viewed the work print and also viewed or read the narration and made corrections.

The object of the picture, sir, was to create a picture for youth in our high schools to point out to them the fact that regardless of what they do, they must slow down. They must drive slowly and if they are involved in an accident they are going to get injured. This was the object of the picture.

Mr. FRIEDEL. I noticed in your rollover picture there that you had the doors off. I don't think that driver would dare attempt a rollover without a seat belt.

Mr. WHITE. He did in one test to show, our doors are what we call triple pinned. We drilled the doors and put a three-quarter inch pin through locking both doors against the pillar. We remove all present-day seats and put in a regular type of aircraft seat bolted to the frame, remove all knobs, sun visors and things of this nature. We wouldn't dare attempt it without this. In other words, it is a

completely modified interior environment to prevent any high pressure point being present.

Mr. FRIEDEL. You said you were in the manufacture of automobiles?

Mr. WHITE. I manufactured precision instruments for 25 years in the automotive industry.

Mr. FRIEDEL. But not automobiles?

Mr. WHITE. Not automobiles, no, sir.

Mr. FRIEDEL. That is all the questions. Mr. Loser?

Mr. LOSER. I have no questions.

Mr. FRIEDEL. Mr. Schenck?

Mr. SCHENCK. I have no particular questions because we have seen these actual crashes. I think it was very interesting and probably would be valuable for driver training courses.

Mr. WHITE. This was the object of the film basically, but it does document the amount of work that motor vehicle research has done in the field of crash deceleration.

Mr. SCHENCK. Did you do any experimental work with governors on cars?

Mr. WHITE. We did do one experimental project with the State of New Hampshire regarding what they call the father and son governor, by which a device was mounted on the dashboard that cut the ignition out at a predetermined speed.

This speed was fed to the device by means of a cable on the speedometer. We found the device was effective in reducing or cutting the speed off at any predetermined point. However, by cutting the ignition and allowing the engine to keep operating on a pump action, we sucked enough raw gas into the internal parts of the engine and the muffler system to blow it out on downhill operation. The commissioner of the State of New Hampshire asked us to test the device because the device had been given to them for sanction and use in the State.

We also used the device among a series of young boys in a hotrod club, asking them to take the car out, drive it and see if they could violate it. The violation was very simple by means of removing one wire from the device itself and attaching it to the priming side of the ignition coil. Therefore, they could violate it. In other words it was not a device that was foolproof. Second is, we felt that fire may occur in the vehicle with enough raw gas being fed into the exhaust system with no ignition to ignite it during the operation time of going downhill or on the road.

Mr. SCHENCK. Do you feel that governors on automobiles are of any particular safety advantage?

Mr. WHITE. This is a question, sir, that I am not qualified to answer.

However, I do feel that we should have a realistic speed.

I would like to point out one thing. If we have a speed posted limit of 60 miles per hour on a highway, why should we provide individuals with cars capable of speed up to 110 miles per hour? If we simply took a ringer pin and put it in the rear end changing the ratio you would have all the passing power you could use. The coefficient between the wheels and the road would be so low you could burn the tires off the car but have all the passing you want. So why do we pay for horsepower for 110 miles an hour when we have a realistic speed for the average human and a posted speed of 60 miles on our highway?

Modification of engines and increasing horsepower requires a lot of money. If we could funnel this money into a basic redesign of the vehicle and have a more realistic speed I think we could do a better job. Of course, this is an opinion.

Mr. SCHENCK. You have a feeling that it is not necessary to have high power to develop acceleration?

Mr. WHITE. No, sir, because horsepower and torque curves are clearly related in reference to performance. If you took the same automobile you have today with a 3.1 rear-end ratio with a horsepower rating of 275 and changed this rear-end ratio so the car would go 60 miles an hour only, you could not use all the performance because the coefficient of friction between the tire and the road and torque curve would cause the wheel to spin so you would have all the passing power you wanted, in fact, too much.

I think there are figures available as to the horsepower necessary to propel a 3,000-pound vehicle which does not exceed 17 at 50 miles an hour with good aerodynamic characteristics and low drag on the tires or on the road between the tires.

Mr. SCHENCK. Of course you get the same thing with an automatic transmission that would drop down, would you not?

Mr. WHITE. Exactly, provided an overdrive shift to take care of the economy factor and reduce the noise level in the vehicle and you have a vehicle that will not exceed the speed limit, yet will give you all the acceleration economy you require.

Mr. SCHENCK. And you would still get economy with reduced rear axle ratio?

Mr. WHITE. By providing an overdrive to change that ratio when necessary as we have provided in some of our cars in the past. However, to provide a governor situation or system in an automobile for all automobiles, I think that you would have to start at the beginning, because governors are very easy to violate. Our young folks are the folks that we have to look to. They are only interested in as much noise as they can get out of the car and as much acceleration as they can possibly get. To provide a governor of the Hough type would be futile because those boys can violate them by overrunning them down a hill, but if the rear end ratio was set there would be no problem.

Mr. SCHENCK. The safety factor or one of the safety factors is the amount of time spent in the passing lane; is that not true?

Mr. WHITE. That is true because if you are caught out there with a car in the opposing lane coming at you and you do not have acceleration, you are a sitting duck.

Mr. SCHENCK. And so if you add your gear ratio set to a predetermined 60 miles per hour speed, as you suggest, it would be just as effective as far as making you a sitting duck as would a governor if it shuts down the motor?

Mr. WHITE. True, but if a man is traveling in front of you at 60, why do you want to pass him if you know the speed limit is 60 and you have a governor or you have a rear end ratio that will not allow you to exceed 60 per hour?

Mr. SCHENCK. There, of course, you are getting into the human factor which we are probably unable to control.

Mr. WHITE. This is quite a problem.

Mr. SCHENCK. That is all, Mr. Chairman.

Mr. FRIEDEL. Thank you very much, Mr. White.

Mr. WHITE. Thank you, sir.

Mr. FRIEDEL. We have a statement by Mr. Jonathan Karas and we will insert that in the record.

(The document referred to follows:)

SAFETY AND/OR STYLE?

By Jonathan Karas, University of New Hampshire, Durham, N. H., and consultant to Motor Vehicle Research, Inc., South Lee, N. H.

"Last year's toll of traffic dead soared beyond 40,000 persons. One and one-half million citizens were injured. Many were disabled for life. The estimated cost to the country was $4,750 million.

"We simply cannot let this go on. The cost of inaction is prohibitive. Who is going to fill the vacuum? Someone must, and someone will. Are we willing that, once again, it be Washington, D. C.?"

So stated President Eisenhower in an address to the 49th Governors' Conference at Williamsburg, Va., on June 24, 1957.

To the citizens in the statistics mentioned above the problem of safety is very real; to the rest, the fact that only one-fortieth of 1 percent of our population was wiped out is probably a low price to pay for the convenience of motoring. Even the 1 percent injured might not seem high—except to those injured and their families and friends.

The immediacy with which safety is designed into our cars depends upon whether you are unimpressed by percentages or shocked by numbers. For 40,000 dead represents the entire population of Santa Fe, N. Mex., or Vicksburg, Miss., or Phenix City, Ala. And the one and a half million injured fill all the homes in Pittsburgh, Pa., or Cleveland, Ohio. Looking at it this way certainly indicates we have a problem on our hands. The question that is always asked is, "What can we do about it?"

One solution would be to set up a crash program—such as the one that developed the atomic bomb. These are situations in which cost is secondary to the end result. With unlimited funds there is no question that a vehicle could be designed which would completely protect the passengers if the vehicle hit a stone wall at 50 miles per hour. Let me hasten to add that such a device would bear no resemblance to the projectiles on our highways today—but it could be done. However, let us be realistic and concede that such a crash program has little chance of initiation for the "accidents always happen to the other fellow so why should I worry?"

The purpose of this paper is to offer some concrete suggestions as to how to save lives on an economic basis. Some of the suggestions that follow could be incorporated into modern vehicles within the next hour and would, in fact, lessen the overall price of a car. You might well ask how a safer car can be built at a lower cost. This is the question that, presumably, I am about to answer.

Please keep in mind that the ideas proposed will not save all the lives nor keep all the injured healthy—but I guarantee you that they will save some lives. And to the particular person who thwarts death this is a mighty important point. This person could be one of us here today.

Personally, from my own observations, I am convinced that the shape and form of modern cars are under the complete control of the stylist—who must design something that will sell. Everything else is secondary—or so it appears. Once the car assumes its contemporary art form the safety engineer is then allowed to make changes—providing they do not interfere with the styling.

Safety engineers and stylists may take violent exception to the previous point. As a citizen who owns and drives a modern car I am entitled to ask certain questions regarding my purchase. These questions will be asked shortly and I shall be eager to receive answers or evidence that my fears are unfounded.

I offer the points for what they are worth and feel confident that their adoption will save lives and lessen injuries.

Let us begin asking a question. Why do many modern cars have hood ornaments? Consider the representative hood ornaments available today. These are deadly projectiles which can disembowel a youngster on a bike or pierce the chest of a passenger in a side collision. Certainly, they are works of art—but are deadly and, it seems to me, totally nonfunctional. Are such ornaments used

to aim the vehicle, give it a sense of motion, aid in aerodynamic stability, or are they a throwback to the old exposed radiator cap days? Some cars even have two such weapons—and three or more may be just around the corner. Why do we insist on impaling our citizens as well as striking them? I wonder how many people would notice if you removed this ornament from your car. It might be interesting to try and see. Bumper ornaments and jet-plane radar nose attachments are in the same category. Would it be possible to have a gentlemen's agreement that next year's cars simply have no hood ornament?

Frankly, the number of lives this would save is unknown, but I am sure that someone would benefit.

Next, let us move inside the car and discuss another minor, but deadly, point. Do you know that in many impacts a sharp, rigid, 8-inch metal edge is available which can decapitate a child or fatally injure an adult passenger by crushing his chest? Think about it. Where is this deadly edge which remains hidden until the critical moment? Yes, the normally handy glove compartment can kill you, and this happens every day. For, under impact, glove compartment doors unlatch and drop down to become an unsheathed guillotine. You might try striking your own dashboard sharply just above the latch to see what will happen. This has happened time and time again and is causing needless pain and suffering. Yet, year after year, new models come out with the same handy, but deadly, arrangement. Again, let us not criticize without being constructive. As a solution could we consider a glove compartment door hinged at the top, or perhaps, a door that slides?

To discuss fully the demerits of the stylized pointed knobs generously sprinkled over our dashboards would require a separate dissertation. Think about the typical radio arrangement. Must the knobs be spaced and positioned so as to blind and disfigure the hapless passenger? Is no other less lethal styling acceptable? Does the American public really closely examine these knob arrays as a point of sales appeal? If the knobs were flat, smooth, and soft would it really be noticed on the sales charts? In fact, who would really care if they were on the under edge of the dashboard where common sense dictates they must be for safety? Is the dashboard there to dash your brains out or to help you in the unforeseen event of a collision? Every time I look at the dashboard of my car I shudder and since it will not operate without the "spaceship controls" all I can do is hope for the better. It would take a phenomenal design to make dashboards of some cars more deadly than they are this moment. Remember that the average American motorist cannot build his own car as he sees fit so of necessity he must depend on the manufacturer to help save his life. Isn't it about time this dependence was recognized?

Imagine being struck by a pop bottle or a hand electric drill moving at 60 miles per hour. If you are wondering how these items got into the discussion reflect on the variety of objects placed on the rear-window ledge of a modern automobile. People have carried everything from Thermos bottles of coffee to cartons of shotgun shells on this handy storage place. Practically everyone has been exposed to advertising schemes urging us to place certain brand items such as soft-drink bottles on this ledge so as to win a prize for having the products noticed by a secret spotter. This handy ledge must go for it conditions us to an unsafe condition. The elementary laws of nature tell us that if the vehicle is suddenly stopped the loose objects will tend to continue in the original direction the car was moving, that is, straight ahead and into the head of the driver and passengers. Thus, in order to help us carry more items car designers have unconsciously added an additional safety hazard. Again this is a point whose absence would affect sales inconsequentially.

Station wagons are becoming more and more popular because of their versatility. Not only can they carry large numbers of passengers but they can convert into efficient and spacious load carriers. They are upholstered to make cleaning easy and the materials used are tough and wear-resistant. These are points in which station wagons excel.

But, there are disadvantages too. However, if we are interested in safety some of these disadvantages can be eliminated easily by design.

The indiscriminate use of smooth plastic materials can make station wagons lethal even under panic-breaking conditions. Reflect on what can happen when the load being carried slides forward easily under any conditions which tend to stop the car. Under impact conditions the load being carried becomes a force of hundreds of pounds suddenly thrust against the backs of people in the front seat. This is especially dangerous when the front seat is hinged to move for-

ward in the two-door models. There are two solutions suggested for this problem, one elementary and the other a bit more trouble. Both changes will help save lives.

The smooth plastic materials used on the station wagon rear decks should be replaced by coverings with appreciably more friction. This would reduce the random skidding of objects under normal driving conditions of accelerating and decelerating. However, even such materials will not keep the load from shifting under impact conditions so other measures are necessary. Perhaps a hinged bar behind the front seat could be fastened when carrying a potentially dangerous load. Neither of these suggestions would be costly and certainly would be a step in the right direction.

Even trucks do not escape these disadvantages. A typical panel truck whose seat is hinged becomes a pincers when the load shifts under fast braking or impact conditions.

Is there not reason then to inquire whether vehicles purchased to transport loads are designed to safeguard the passengers under load-shifting conditions? Or are we to presume that the loads may not, or will not, shift? Certainly even mild crash deceleration tests under loaded conditions would vividly demonstrate these design flaws which could then be remedied. With tremendous testing facilities available to major manufacturers there is no excuse for lack of realistic crash testing. In case the fact has slipped our minds let us recall that one and a half million people are injured annually in this mechanized but undeclared war against humanity.

Let us return again to the passenger car. Spacious trunks have always been a sales point for the American family. For how many of us have unmercifully stuffed and compressed suitcases, carriers of bottles, tool boxes, cans of gasoline, and an inconceivable variety of other household goods, into these spacious trunks? But how much consideration has been given to what might happen under panic braking or impact conditions? To see what happens let us look at actual tests of the effect of load shift. The load in this case is three cement blocks. Now, let us look at what happens when the load shifts under impact conditions. From this angle it appears the load merely shifted forward unimpeded by the decorative cardboard trunk barrier. But had you been sitting in the rear seat you probably would never see again. Here you see the shift load swept away the cardboard, tore loose the metal strips used to keep the rear seat in place, thrusting the rear seat violently against the front seat. Any rear seat passengers would have sustained double-barreled injuries. Not only are they impacted on the back of the front seat but the trunk load crushes them from behind. Can you imagine what such forces would do to a human spine?

We are led to believe that you are only as safe as your tires. Poorly made or maintained tires certainly can be lethal. Any driver who propels himself along the highway at 60 miles per hour on unsafe tires has only himself to blame when they fail after many thousands of miles of useful service. Tires are expendable and the careful driver will check them regularly. But what chance does a careful driver have when the wheels on his car fail? Is he responsible for testing their design at his own risk or may he assume that the manufacturer who places such wheels on his product has tested them beforehand? Look at this steel wheel from a popular brand car. Improperly designed, the wheel failed under stresses imposed when the car went around a corner.

It is hoped that the previous examples serve to illustrate the point being made here; that is, that some safety features can be designed into modern cars without necessitating major changes. In most cases the changes will not only save lives but money as well.

We might well call such design "preventative safety design." The 40,000 killed and million and a half injured are not fiction but grim reality. Anything we can do to lessen death and injury even by a fraction of a percent is a step in the right direction. For example, recall that many States have laws requiring the fireproofing of stage scenery and curtains. By percentages the number of people killed in theater fires is probably negligible—and unnoticeable except to the families involved. But we have recognized that theater fires can occur and have taken simple steps to safeguard ourselves. This is "preventative safety design."

Must we continue to ignore the fact that accidents will occur and do nothing to lessen the fatalities? Is it the problem of the people who buy the cars not to get involved in accidents and thus ignore the whole safety problem? Or should we frankly admit that accidents will occur and do everything possible to lessen the severity?

I shall be interested to learn the answers to the questions posed and shall eagerly await the anticipated changes in design in the interest of safety. Yet, my inner sense tells me that no answers will be forthcoming and that safety will continue to be last on the list of considerations in automotive design—and the automobile will continue to be first on the list of modern weapons, continuing to kill and maim more and more under the guise of modern scientific and engineering achievement.

Mr. FRIEDEL. Mr. Isbrandt, could you be back tomorrow?

Mr. ISBRANDT. Not conveniently, sir; I had made arrangements to be in New York this afternoon.

Mr. FRIEDEL. Then you may proceed.

STATEMENT OF RALPH H. ISBRANDT, DIRECTOR OF AUTOMOTIVE ENGINEERING, AMERICAN MOTORS CORP.

Mr. ISBRANDT. Thank you, Mr. Chairman. I am Ralph H. Isbrandt, director of automotive engineering, American Motors Corp.

As a representative of the automotive industry and also American Motors Corp., I am extremely pleased to be able to take part in these hearings. In the few minutes allotted to me, I shall attempt to set forth some of the past experiences of American Motors with seat belts, and also to discuss some of our current practices, and the reasoning behind these practices. To save your time, I prefer to read my statement and then will be glad to answer any questions you might have.

1. AMERICAN MOTORS CORP. SEAT-BELT EXPERIENCE, 1949–50

The experience of American Motors Corp. with seat belts dates back nearly a decade ago when its predecessor, Nash-Kelvinator Corp., was the first to introduce factory-installed seat belts for passenger automobiles.

Our interest in the possible utility of seat belts was accelerated in 1949 when the company introduced the reclining-seat option for the front-seat passenger in its Nash Ambassador and Statesman cars.

Our early objective was to provide a restraining device for the reclining or dozing passenger, to avoid discomfort during sharp turns, sudden brake stops, or other disturbances caused by road irregularities.

As a result, we developed a seat belt as part of the reclining-seat option, which was installed then at extra cost in a large majority of the total production of our cars. There was no extra charge for the seat belts themselves. The marketing period that included seat belts in the option extended from September 1949 until the early summer of 1950, at which time our original commitment of seat belts had been consumed. A total of 48,141 seat belts were supplied to purchasers as part of the reclining-seat option.

While the reclining seat was promoted as a new and desirable feature, the seat belts were not emphasized in the same manner as was the new seat. As we gained experience with the reclining seat, it appeared that this feature actually did not create an increased need for a restraining device. If anything, the individual in a reclining posture appeared to be at least equally safe under impact as the passenger in the normal, seated position.

Favorable reaction from car users to the reclining seat was prevalent, but the belts were not accepted with the same enthusiasm. In many cases the belts were entirely ignored. Buyers frequently removed the belts after a short period of use. In a few instances the new-car buyers even ordered the belts removed from the car and discarded before accepting delivery of the vehicle. The motoring public at that time appeared to be just not ready for seat belts or restraining devices.

This experience proved, without a doubt, that seat belts would not sell themselves and that to promote their use successfully would require an extensive educational campaign, directed at the driving public, pointing out their use and value.

2. DEVELOPMENT OF AMERICAN MOTORS ACCESSORY SEAT BELTS

These were an item added to our accessory line in 1955.

In 1955, American Motors again offered a seat belt, at this time as a specific item in its line of automotive accessories. In view of Nash Motors' experience in 1950, the marketing approach was changed so that belts were available only to some purchasers who were sufficiently interested in the belts to purchase them.

As some members of this committee will recall from action films shown during your field trip a year ago, American Motors engineers, in conjunction with one of the large universities, has carried on extensive tests, evaluating the effects of crashes upon the occupants of the automobile, as well as the components of the automobile itself.

A further close liaison was developed with other automotive manufacturers. Their experience and technical information was exchanged through the seat belt committee of the Society of Automotive Engineers, formed early in 1955. Representatives of this committee included all of the automobile manufacturers, several automotive parts suppliers, and aircraft seat-belt manufacturers.

These industries voluntarily made available their wide and varied experience in the application and development of seat belts and their attachments.

The belts which were finally released for sale by American Motors and introduced late in 1955 complied with all of the provisions of the still unofficial SAE recommended practice covering motor vehicle seat belt assemblies.

3. SAE SEAT-BELT ACTIVITY

The SAE work mentioned above was initiated in 1954. That year the automobile industry, through the Automobile Manufacturers Association, recognized the widely publicized discussions of seat belts as a factor in motor-vehicle safety and requested the SAE to undertake a study of the subject. As a result of this request, the technical board of the SAE in their meeting of January 13, 1955, appointed the motor vehicle seat-belt committee. This committee has among its membership outstanding men from the automobile industry, the automotive parts suppliers, and nationally recognized organizations that were technically competent to contribute to the study of safety of the occupant in automobiles.

American Motors has had active representation on this committee. In the early months of the investigation and study, it was apparent that facts and specific engineering data were conspicuously meager,

but there was no lack of unfounded opinions from unqualified individuals outside the automobile and other transportation industries.

Gradually, basic engineering facts were developed through extensive tests conducted by the automobile companies and made available to the SAE committee by the individual representation of these companies on this committee.

As a result of this work, the SAE issued a recommended practice covering motor-vehicle seat-belt assemblies, which is published as a part of the 1957 SAE Handbook (p. 974).

This practice was first issued in November 1955 and revised in September 1956. These standards are still subject to expansion and revision as new information and knowledge is obtained as to seat-belt requirements, tolerance of the human body to impact loads, et cetera.

Present SAE standards are based on a 3,000-loop load, which is equivalent to approximately 20 *G* deceleration force on a 150-pound occupant.

4. SEAT-BELT ANCHORAGE IN AMERICAN MOTORS UNITIZED BODIES

American Motors recognized early that a seat belt would be no stronger than its weakest element, including the mounting or anchorage structure. Anchorage to a structural member of the car was most essential. Tests on American Motors cars indicated that anchorage to the body understructure would be satisfactory, and early tests showed that the floor-pan structure would withstand a static load of 9,000 pounds, or the equivalent to 3 seat belts for the front-seat occupants, each loaded to 3,000 pounds, as specified in the SAE recommended practices. The specified areas of belt anchorage are amply reinforced by nearby underbody members, and by contours of the floor pan itself. The 9,000-pound test load provides ample margin for customary installation of 2 belts for front-seat occupants.

In addition, it is well recognized that dynamic loading, rapidly applied (as in a crash) is less severe than static loading of the anchorage as in laboratory "pull tests." The observed yielding action of the floor-pan anchorage is acceptable and desirable, as the resulting flexibility provides a controlled cushioning action at high belt loads, thereby moderating the restraining forces on human occupants during crash impacts.

Belts for rear-seat occupants in American Motors cars also are anchored to the floor and rear wheelhouse structure. Here too, the structure is amply strong to withstand belt loads, as the shape and thickness of the floor pan and presence of nearby supporting underbody structure all serve to produce strength far beyond that required.

5. SEAT-BELT SALES BY AMERICAN MOTORS

The American Motors Corp. seat belts are priced retail at $9.95 per unit, plus installation. Sales to dealers totaled 2,475 units for the 1956 calendar year, representing 1.19 percent of production of Rambler, Nash, and Hudson automobiles during the same period (assuming 2 seat belts per automobile). Sales during the first half of 1957 have been at practically the same rate—1.18 percent of car production.

CONCLUSION

We feel that our experience to date does not provide us with adequate information on which to base positive conclusions. The best we can say is that we have found very little interest in seat belts on the part of car buyers, and that our observations indicate we are still in development stages of the inquiry into adequate restraining devices.

Thank you, Mr. Roberts, for the opportunity of appearing before your committee.

Mr. ROBERTS. Thank you, Mr. Isbrandt. It is a pleasure to have you before the subcommittee and the subcommittee has certainly profited from its visit to Burlington. I think that is the first visit that we paid to the industry, and we think that we learned a great deal from it and we are grateful to you for the part that your company played in that hearing at Burlington.

I regret that I was not able to be here for all of your statement. But I believe your company was the first to factory install seat belts for passenger vehicles.

Mr. ISBRANDT. That's correct.

Mr. ROBERTS. Has your experience been that the seat belt makes a definite contribution to passenger safety?

Mr. ISBRANDT. Yes, I would say it has been that. I believe, though, that in the future we will see further developments of restraining devices that will probably take us further than the present seat belt as we know it today.

Mr. ROBERTS. And you would agree in substance with testimony of Dr. Griswold that properly installed seat belts save lives.

Mr. ISBRANDT. Yes; I would. I would like to emphasize a little personal experience. It is about 3½ years ago that I had seat belts put in my own cars, and in practically every case where somebody rode with me that had not ridden with me before the belts were in the car, I always had the problem of reassuring them that the belts were not because we were going to do any stunts or anything of that type.

The belts were in there for the purpose of restraining and helping in the case of an accident and eliminating the possible severe injury that could occur if somebody ran into us. I think the education of the public is going to play a great part in the use of belts. Of course, in addition to that I think educational programs directed at safe driving are, of course, of immeasurable worth.

Mr. ROBERTS. And you would certainly disagree with the conclusions which Mr. White reaches as to the contribution made by seat belts?

Mr. ISBRANDT. Yes; I would say I would.

Mr. ROBERTS. How long have you been in the industry, Mr. Isbrandt?

Mr. ISBRANDT. I started in the automobile industry in 1926.

Mr. ROBERTS. How long have you been with American Motors?

Mr. ISBRANDT. I have been with American Motors just short of 4 years.

Mr. ROBERTS. Your segment of the industry uses a different type of construction from the rest of the industry. Would you care to elaborate on that feature?

Mr. ISBRANDT. Yes, we use the unitized body construction. It so happens that the corporation used it before I became responsible for the engineering as director of engineering. However, in my previous experience with one of the other manufacturers we studied unitized body in the case of a new-model automobile. We did not go to them at the time because of the extreme cost that was involved in retooling our plant. From my feelings from the experience with American Motors and studies of accidents that have been made, we believe that there are basic advantages in unitized body construction. They pose some problems somewhat different from the conventional automobile construction in the attachment of belts, as an example, and there I would like to point out that the seat belt committee of the SAE recognized this condition, and it was not without a considerable amount of study and testing that the standards were set up as they are set up right now for attachments as well.

Mr. ROBERTS. Do you think it would pose any major engineering problem as far as your company is concerned to provide proper attachments or make provision for putting holes in the frame so that seat belts could be attached by a customer after he gets his car?

Mr. ISBRANDT. It would undoubtedly because there would be some increase in cost. We would then be faced with the problem that we are with so many accessories when they are introduced in that you penalize the cost of the product to all purchasers when you apply an accessory or make provisions for an accessory that can be applied out in the field.

Now, I would like to say, to correct an impression you might have, Mr. Roberts, we do not at present install belts at the factory. Our percentage of production or percentage of sales to production has been so low that it would pose a considerable problem to attach belts at the factory because you must put the workmen there regardless of whether the operation is performed or not. Therefore with 1 percent of your production you can see that the cost would be prohibitive.

Mr. ROBERTS. I was aware of that fact because at one time you did factory install?

Mr. ISBRANDT. Yes.

Mr. ROBERTS. And because there was no great demand for that on the part of the public you abandoned that practice; did you?

Mr. ISBRANDT. That is correct and I wanted to be sure that that point was clarified.

Mr. ROBERTS. The gentleman from Ohio.

Mr. SCHENCK. It is nice seeing Mr. Isbrandt again. You do furnish a package set of seat belts?

Mr. ISBRANDT. Yes, we do—factory specified, engineered under our own direction manufactured by the Hickock Belt people who have been very active in this type of work and are a very reputable firm. They happen to be our present supplier although at the time we set up our specifications some of the aircraft manufacturers of belts also were considered.

Mr. SCHENCK. And you also furnish your dealers with proper instructions as to their installations?

Mr. ISBRANDT. Yes, the instructions are included right with the package.

Mr. SCHENCK. I think that is all.

Mr. ISBRANDT. The gentlemen from Maryland?

Mr. FRIEDEL. Glad to see you, Mr. Isbrandt. I would like to ask just one question. Do you think that the apathy of the public about seat belts is because they are so cumbersome that they lay over the seats on short trips and are in the way? Is that one of the reasons why they don't want seat belts?

Mr. ISBRANDT. I think after you have overcome the psychological problem of convincing the person that you are not going to do any stunt driving, after you overcome that, then I think your second problem is the one of comfort. I know in the case of my own wife, if I insist that she put the belt on, unless I glance over continually I will find that the belt is fairly loose, and it so happens that prior to coming back in the automobile industry after the last war, I spent a considerable number of years in the aircraft industry, having done an awful lot of flying, even in commercial aircraft you will find many passengers who will immediately after the stewardess has passed them and has checked their belt, will loosen it to make themselves more comfortable and, of course, that defeats the purpose of the belt.

Mr. FRIEDEL. Have you seen the seat belts that work by pressing a button and they slide right back, tractable seat belts? Have you seen those?

Mr. ISBRANDT. Yes; I am somewhat familiar with them. I have seen those.

Mr. FRIEDEL. Do you think they are more attractive to the public because they can slide right back into the seat?

Mr. ISBRANDT. I don't think the problem of the belt interfering when not in use is a big one. I don't think so.

Mr. FRIEDEL. That is all, Mr. Chairman.

Mr. SCHENCK. Mr. Chairman, if the gentleman will yield.

Mr. FRIEDEL. Yes, sir.

Mr. SCHENCK. One of the objections that I have heard to seat belts and from my own experience, too, is the fact that anchoring them in the floor behind the seat particularly when the seat slides back and forward to adjust for leg room interferes somewhat with the foot space of the passengers in the rear compartment.

I wondered if you are doing work along that line?

Mr. ISBRANDT. We are studying that problem in our newer models where we have an opportunity to retool an entire floor structure, you see.

Mr. SCHENCK. But you still feel that you must anchor to the frame or to the substantial floor?

Mr. ISBRANDT. We feel that it is very desirable to anchor to the body structure or frame structure itself rather than to the seat because to develop a seat mechanism that is adjustable fore and aft and still withstand 20 *G*'s is a pretty sizable project as is the case in bomber-pilot seats and that type of thing and the seat becomes a very expensive seat as compared to the automotive seat we now know.

Mr. SCHENCK. That would increase the cost.

Mr. ISBRANDT. Oh, tremendously.

Mr. SCHENCK. That is all, Mr. Chairman.

Mr. ROBERTS. I know you are an engineer but I know you are also interested in the success of your company. I notice that your sales this year have been considerably improved over last year.

I believe I am correct.

Mr. ISBRANDT. We are happy about that.

Mr. ROBERTS. Do you think that emphasizing safety in your construction has helped or hurt the sale of your car?

Mr. ISBRANDT. I am certain it has not hurt or impaired in any way the sale of the product. I am certain of that. I do believe that the unitized body is becoming more recognized. People know a little bit more about what a unitized body is, what the term means, and I anticipate that in 1958 some of our competition joining us, that we will have additional help in our sales.

Mr. ROBERTS. Thank you very much, Mr. Isbrandt.

Mr. ISBRANDT. Thank you very much, Mr. Chairman.

Mr. ROBERTS. This will conclude the hearings for today and the subcommittee will stand in recess until 10 a. m. tomorrow morning, the hearing to be continued in this hearing room tomorrow morning at 10 o'clock.

(Whereupon, at 12 noon the hearing was adjourned, to reconvene at 10 a. m., Thursday, August 8, 1957.)

AUTOMOBILE SEAT BELTS

THURSDAY, AUGUST 8, 1957

HOUSE OF REPRESENTATIVES,
SPECIAL SUBCOMMITTEE ON TRAFFIC SAFETY OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The special subcommittee met at 10:10 a. m., pursuant to recess, in room 1302 New House Office Building, Hon. Kenneth A. Roberts (chairman of the subcommittee) presiding.

Present: Representatives Roberts (presiding), Rogers, Loser, and Schenck.

Mr. ROBERTS (presiding). The committee will please come to order.

This morning the Subcommittee on Traffic Safety hopes to conclude its hearings on the crashworthiness of automobile seat belts. It is the sincere hope of the subcommittee that these hearings will have served a public service by setting forth the views of persons who have done research on this safety device in the sincere effort to determine the value of seat belts in an automobile crash.

The subcommittee is extremely grateful to all the witnesses, many of whom have traveled great distances to appear before the subcommittee, who have joined in this mutual effort to provide greater safety for the American public.

Before hearing our first witness this morning, I would like to place in the record a letter sent to the subcommittee by the Administrator of General Services, Franklin G. Floete. Included with the statement from Mr. Hanson is a draft of the proposed Federal specification to be met in the installation of seat belts on federally owned automobiles.

At this time, with the consent of the subcommittee members, I should also like to place in the official record of these hearings the letters commenting on the merits of seat belts which have been received from the States and Territories which have placed seat belts on State-owned automobiles. (See p. 213.)

(The letter from Mr. Franklin Floete, together with the draft of the proposed Federal specification, are as follows:)

GENERAL SERVICES ADMINISTRATION,
Washington, D. C., July 26, 1957.

HON. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety
of the Committee on Interstate and Foreign Commerce,
United States Senate, Washington, D. C.

DEAR MR. CHAIRMAN: As requested in your letter of July 17, Mr. J. B. Hanson, Director, Motor Equipment Division, Federal Supply Service, will be available to your committee July 29 through August 8 inclusive in connection with hearings on crash worthiness of automotive safety belts, if desired. However, GSA has performed only limited experiments with the use of safety belts since we have felt that adequate information is and would continue to be available as a result

of experiments being conducted by various interested parties and from actual experiences of operators and fleet owners.

Accordingly, for some time we have been reviewing the highly controversial subject and in view of our responsibility for the safe operation of Federal motor vehicles we will continue to pay close attention to the national experience with the use of such equipment. Based on information thus far available, we believe that the use of the automobile safety belts would contribute in some degree to the safety of the motor vehicle occupants. However, we feel that at this time the value of safety belts is limited by two major factors:

1. The unreliability of many of the seat belts presently being offered on the market; and

2. The fact that people do not use the belts when they are available.

Many factors could be offered as contributing to the lack of the adequate use of this protective device. The best answers available to us are that many persons feel that the belt creates a certain amount of discomfort, especially in hot weather; unused belts become soiled and there is a natural reluctance to applying soiled belts to clean clothing; and, many drivers, because of personal preference for greater freedom of movement or because they do not wish to be bothered with belts, do not use them.

Many of the products available on the present market are inferior in quality and do not provide for secure fastening to the vehicle. The result is often failure when needed. Realizing our responsibility to provide dependable seat belts in those cases where there is an established need, GSA is engaged at this time in the development of minimum Federal standards which will specify the minimum breaking point of the belt itself and of its attachment to the vehicle.

At this time a few hundred Federal vehicles used for law enforcement pursuit work are equipped with safety belts, also a small number of others have been so equipped on an experimental basis. GSA is considering some limited experiments in the near future. However, at this time because of the difficulty encountered in getting other Federal employees to use seat belts and the other factors previously cited, we do not believe that the cost of installation on approximately 200,000 other Federal-owned motor vehicles can be justified at this time.

Sincerely yours,

FRANKLIN G. FLOATE, *Administrator.*

(NOTE.—This draft dated March 19, 1957, has not been approved and is subject to modification.)

PROPOSED FEDERAL STANDARD NO. 119—BELT; SAFETY, PASSENGER TYPE, AUTOMOTIVE, METHODS OF INSTALLATION

(Approval paragraph to be inserted in the final draft submitted for approval.)

S1. *Purpose and scope.*—This standard establishes the methods for installing automobile passenger safety belts in motor vehicles which have been adopted to achieve the highest degree of uniformity and standardization for the Federal supply system consistent with the conditions which will be encountered.

S2. *Application.*—Purchases from commercial sources under proposed Federal specification JJ–B–185 (after promulgation) of the issue in effect on date of invitation for bids, shall be installed in accordance with the applicable method described herein.

S3. *Standard characteristics.*—The standard methods of installation shall conform to the characteristics listed below:

(*a*) *General (applicable to all methods).*—

1. Installation of seat belts shall be made only after full consideration has been given to the following: The top and underside of the vehicle floor panels or frame members or frame members and panels of storage compartments, in the case of rear seat installation, shall be carefully examined for corrosion or other weakness caused by deterioration, accumulation of moisture or salt air. If there is evidence of excessive corrosion or other weakness which has or could eventually weaken the structure or sheet metal of the floor or compartment panels, methods 1 or 2 below, shall not be used and either method 3 or 4 will be acceptable. Periodic inspection to insure that deterioration of the structure has not occurred and to guard against weaking of the attachment structure after installation, shall be made at intervals not greater than 6 months.

2. The free or attachment ends of belts shall be passed from the front to the rear of the vehicle seat back at the juncture of the seat back and seat cushion and shall be threaded to the point of anchorage or intermediate bar as applicable (see (b), (c), (d), and (e) below), so as to be inclined at an angle of approximately 45° above the horizontal when in use. No belt webbing shall be exposed to the weather or exposed to sharp metal edges when installed. The number of seat belts which shall be installed on one vehicle seat shall not be greater than the number of passengers the seat is designed to normally accommodate and the number of anchorage points as herein described, shall not be less than the number of single occupancy belts installed on the seat. All holes made in the metal of the vehicle for purposes of installation of belts, shall be drilled and shall have all burrs removed. The diameter of a drilled hole shall not be more than one-sixteenth inch larger than the diameter of the bolt or cable it accommodates. At assembly, nuts shall be secured on bolts by drilling and pinning or wiring, or by peening or upsetting of the bolt threads. All anchorages shall be made with full metal to metal contact between anchorage hardware and the vehicle floor panel and/or frame metal.

(*b*) *Method 1, floor bolted anchorage (with belt webbing threaded directly to point of anchorage)*.—Each of the points of belt anchorage shall be accomplished as shown in figure 1. The location of the anchorages shall be such that when the seat is at the farthest rear position of adjustment, if provided, and the belt is in tension, the belt shall not be inclined beyond the vertical to the rear. Further, the location of the anchorage shall not be farther to the rear than is required to fulfill the above conditions. The reinforcing plate shall be mounted over the anchorage bolt and shall have the entire surface of one side bearing upon the underside of the floor panel.

(*c*) *Method 2, floor bolted anchorage (with belt webbing secured indirectly to the point of anchorage through a bar and cable)*.—Each point of anchorage shall be as shown in figure 2. The bar shall be secured to a rigid metal member of the seat frame. The bolt hole locations for the anchorage shall permit full travel of the seat and the cable shall be taut when the seat is at the farthest point of forward adjustment. This can usually be accomplished by making the cable hand taut when the seat is at the midpoint of its travel.

(*d*) *Method 3, frame anchorage (with belt webbing secured indirectly to the frame through a bar and cable)*.—Each point of anchorage shall be as shown in figure 3, and the bar shall be installed as described under method 2. The tension on the cable shall be as described under method 2.

(*e*) *Method 4, frame bolted anchorage (with belt webbing secured directly to anchorage bolted through the frame or indirectly through a bar and cable to anchorage bolted through the frame)*.—Each anchorage shall be as shown in figures 4a or 4b. Holes drilled in the frame shall have their centers located at least one diameter from any exposed edge of the frame member. Frame bolted anchorages with belt webbing secured directly to the anchorage (see figure 4a), shall conform with the requirements of method 1, as to location with respect to the vehicle seat. Frame-bolted anchorages with belt webbing secured indirectly through a bar and cable (see figure 4b), shall conform with the requirements of method 2, except that the anchorage bolt shall pass through the floor panel and a frame member and the reinforcing plate under the floor panel shall be omitted.

S4. *Changes*.—When a Federal agency considers that a Federal standard does not provide for its essential needs, written request for adding to or otherwise changing the standard, supported by adequate justification, shall be sent to the Administration. This justification shall explain wherein the standard does not provide for essential needs. The request shall be sent in duplicate to the General Services Administration, Federal Supply Service, Standardization Division, Washington 25, D. C. The Administration will determine the appropriate action to be taken and will notify the agency.

S5. *Conflict with reference specifications*.—Where the requirements specified in this standard conflict with any requirement in a referenced specification, the requirements of the standard shall apply. Nature of conflict between the standard and the referenced specification, shall be submitted in duplicate, to General Services Administration, Federal Supply Service, Standardization Division, Washington 25, D. C.

Notice: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifica-

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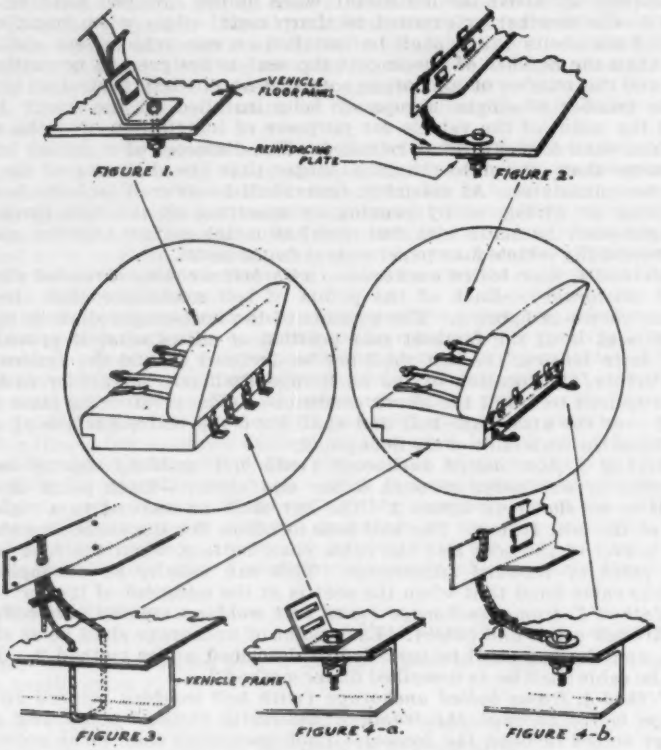
tions, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.



(NOTE.—This draft dated March 19, 1957, prepared by the General Services Administration, Federal Supply Service, has not been approved and is subject to modification.)

PROPOSED FEDERAL SPECIFICATION—BELT; SAFETY, PASSENGER TYPE, AUTOMOTIVE

(Approval paragraph to be inserted in the final draft submitted for approval.)

1. SCOPE AND CLASSIFICATION

1.1 *Scope.*—This specification covers requirements for automotive, passenger type safety belts, complete with necessary component parts for installation in motor vehicles having covered, rigid, passenger and operator compartments.

1.2 *Classification.*—Safety belts furnished under this specification shall be of the following 2 types and 3 styles:

1.2.1 Types:

Type I: Front-seat installation
Type II: Rear-seat installation

1.2.2 Styles:

Style 1: One belt
Style 2: Two belts
Style 3: Three belts

2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS

2.1 The following specifications and standards of the issues in effect on date of invitation for bids form a part of this specification.

Federal Specifications:
DDD–S–751: Stitches, seams, and stitching
CCC–T–191: Textile test methods
PPP–P–31: Preservation, packaging, packing and marking of material; and shipping instructions
Federal Standards:
Proposed Federal Standard No. 119, belts; safety, passenger type, automotive, methods of installation No. 119
Federal Standard No. 595: Colors
Federal Standard No. 102: Preservation, packaging, and packing levels.
Military specification:
MIL–T–7806: Thread, Nylon
Military standard:
MIL–STD–105: Sampling Procedures and Tables for Inspection by Attributes

(Activities outside the Federal Government may obtain copies of Federal Specifications and Standards as outlined under "General Information" in the Index of Federal Specifications and Standards and at the prices indicated in the index. The index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration regional offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.

(Federal Government activities may obtain copies of Federal Specifications and Standards and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

(Copies of Military Specifications and Standards required by the contractor in connection with specific procurement functions, should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 *Other publications.*—The following publication of the issue in effect on date of invitation for bids, forms a part of this specification:

American Society for Testing Materials: ASTM B–117–54T method of salt spray (fog) testing, tentative

(Copies of ASTM standards may be obtained upon application to their address at 1916 Race Street, Philadelphia 3, Pa.)

3. REQUIREMENTS

3.1 *Qualification.*—Safety belts furnished under this specification, shall be a product which has been tested and approved in accordance with the qualification tests described in section 4. (See 4.2.3 and 6.3.)

3.2 *Materials.*—All metals shall be of a corrosion resisting type or protected to resist corrosion as required in 3.4.5.

3.3 Design and construction.

3.3.1 *General.*—The safety belts shall be designed for single occupancy. No rivets shall be used in the belt webbing. Belt ends may be attached to a common anchorage, provided the total number of anchorages is not less than the number of single occupancy belts. Belts shall be designed to be attached directly to the point of anchorage as shown for a two-occupant installation in figure 6 or the belts shall be secured indirectly to the point of anchorage through a bar and cable as shown for a two-occupant installation in figure 7.

3.3.2 *Webbing.*—Webbing used in the belts shall be of nylon, Dacron, or nylon and Dacron, 1¾ to 2¼ inches wide by 40 inches long for the nonadjustable side and 55 inches long for the adjustable side of the belt. Cut ends of webbing shall be treated to prevent ravelling.

3.3.2.1 *Color.*—Unless otherwise specified, safety belts shall be furnished with grey webbing to match color No. 26173 of Federal Standard No. 595. Colors and dyestuffs used shall not cause deterioration or damage to weaken the fibers of safety belts under normal storage or use conditions.

3.3.3 *Sewing.*—Sewing used on webbing shall be with 7 to 9 stiches per inch in accordance with Federal Specification DDD–S–751, type 301. Webbing shall

be looped back upon itself sufficiently to permit not less than 3 inches of longitudinal stitching per row on the double webbing. Ends of all rows of stitches shall extend one-eighth to one-fourth inch beyond the end of overlaps of webbing and the ends of all stitching shall be backstitched a distance of not less than one-half inch.

3.3.3.31 *Thread.*—The thread used for sewing shall be three-cord nylon thread in accordance with military specification MIL–T–7807, type I or type II, class 1.

3.3.4 *Hardware.*

3.3.4.1 *Buckles.*—Buckles shall be a metal to metal type with a positive cam type lock capable of being opened with either hand. The buckle shall have a friction-type belt length adjustment on one side.

3.3.4.2 *Attachment hardware.*—The belts shall be furnished complete with suitable hardware and fittings to permit installation in a vehicle in accordance with proposed Federal Standard No. 119. Each hold-down bolt shall be provided with nut and washer.

3.3.4.3 *Floor bolted anchorage.*—An anchorage designed to be bolted through the vehicle floor panel only shall be secured through a formed steel plate similar to that shown in figure 6–a or through a cable loop similar to that shown in figure 7–b. The loop of the cable passing around the anchorage bolt shall be served with wire or clamped by metal to prevent its slipping over the bolt head and there shall be a reinforcing plate at least $\frac{3}{32}$-inch thick by 1 inch in diameter directly between the bolt head and the cable loop.

3.3.4.3.1 *Reinforcing plate.*—The floor bolted anchorage shall have a flat steel reinforcing plate, see figure 6–a, at least $\frac{1}{8}$-inch thick by 10 square inches in area with the bolt hole located at the center. The plate may be continuous between anchorages.

3.3.4.4 *Frame anchorage.*—An anchorage designed to be secured to a vehicle frame member by a cable around the member shall be similar to that shown in figure 7–a. The cable shall be of 1 piece fastened by at least 2 U-bolt cable clamps equipped with nuts and lockwashers.

3.3.4.5 *Frame bolted anchorage.*—An anchorage designed to be bolted through a frame member of the vehicle shall be secured through a formed steel plate similar to that shown in figure 6–b, or through a cable loop similar to that shown in figure 7–b. The cable loop shall be as described in 3.3.4.3 above.

3.3.4.6 *Belt anchorage bar.*—The bar provided with belts designed to be secured indirectly to the point of anchorage as shown in figure 7, shall have provision for securing to a rigid metal member of the seat frame by means of at least 4 threaded fasteners of $\frac{1}{8}$-inch diameter. The bar shall not extend beyond the edges of the seat and exposed corners shall be rounded and have all sharp edges removed.

3.3.5 *Weight.*—The weight of the belt for each occupant including buckle and webbing but excluding attachment hardware specified in 3.3.4.2, shall not exceed 1 pound.

3.3.6 *Finish of metal parts.*—All metal parts shall be free from burrs and sharp edges.

3.4 Performance.

3.4.1 *Breaking strength, webbing.*—The breaking strength of the webbing used in the belts, shall not be less than 4,500 pounds when tested as specified in 4.3.2.

3.4.2 *Tensile strength (each occupant), belt assembly.*—The safety belt assembly including webbing and all parts integral with the belt which are necessary for installing the belt, shall be designed to withstand at least a 3,000-pound load applied for 30 seconds in alinement with the anchored belt according to the test requirements as specified in 4.3.3. The belt assembly shall show no visible evidence of failure or damage to the webbing, sewing, and metal parts or any permanent deformation of the metal parts. When tested, slippage of the webbing through the adjusting device and attachment hardware, shall not exceed 1 inch.

3.4.2.1 *Tensile strength, common anchorages.*—Common anchorage hardware shall withstand a load equal to the number of belt ends anchored times the 3,000-pound load for 30 seconds as required in 3.4.2.

3.4.3 *Loop strength (each occupant), belt assembly.*—When tested as specified in 4.3.4, the assembled belt shall withstand a minimum loop load of not less than 5,700 pounds applied for 30 seconds. The assembly shall show no evidence of weakness or failure as specified in 3.4.2. The release mechanism of the buckle and buckle latch shall be operable after this test. Damage, such as broken sewing thread without complete separation, broken or frayed webbing without complete separation of the webbing, deformation but not rupture of the hardware or metal parts, is permitted.

3.4.4 *Release mechanism, buckle.*—When tested in accordance with 4.3.5 the force required to open the buckle, shall not exceed 45 pounds.

3.4.5 *Corrosion resistance, metal parts.*—All metal parts of the belt assembly including attachment hardware, shall be capable of successfully completing the test specified in 4.3.6 without corrosion.

3.4.6 *Color fastness, webbing.*—Color fastness of webbing used in safety belts shall be at least "good" to light and laundering when tested as specified in 4.3.7.1 and 4.3.7.2, respectively.

3.4.7 *Abrasion resistance, webbing.*—The webbing shall lose not more than 5 percent of its original breaking strength (see 3.4.1) after being subjected to the abrasion specified in 4.3.8.

3.5 *Instructions.*—Each safety belt assembly shall be furnished with printed instructions which clearly and concisely set forth installation directions, including anchor-mounting instructions, location, and dimensions for mounting, threading of webbing between cushion and back of seat, threading of webbing at attachments, reinforcing of floor; general directions for use, cleaning, cautions to the installer as to sharp or rough edges, and warnings against bleaching or dyeing.

3.6 *Marking.*—Each half of the safety-belt assembly shall be permanently marked to provide identification of the manufacturer and belt model.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 *Sampling.*

4.1.1 *Inspection lot.*—All belts and attachments of one type offered shall be considered a lot for purposes of acceptance, inspection, and tests.

4.1.2 *Sampling for inspection.*—Sample belts and attachments shall be taken in accordance with quantities listed in table I from each inspection lot of material offered for Government inspection of visual and dimensional characteristics with lot acceptance based on the sampling inspection requirements in accordance with Military Standard MIL–STD–105.

TABLE I.—*Sampling for visual and dimensional inspection AQL (approximately)=1.5 percent defective*

Number of belts and attachments in inspection lot	Number of belts and attachments in sample	Acceptance number (defectives)	Rejection number (defectives)
25 or under	10	0	1
26 to 65	15	0	1
66 to 110	25	1	2
111 to 300	35	1	2
301 and over	50	2	3

4.1.3 *Sampling for lot acceptance tests.*—A random sample of belts and attachments shall be taken from each lot offered for Government testing in accordance with table II, and shall be subjected to the applicable tests specified in 4.3. The number of belts and attachments selected shall consist in each case to the appropriate number of samples of each model belt offered.

TABLE II.—*Sampling for lot acceptance test*

Number of belts and attachments in lots:	*Number of belts and attachments in sample*
40 and under	2
41 to 110	4
111 to 300	6
301 and over	8

4.1.4 *Sampling for qualification tests.*—The manufacturer shall submit the following from his regular production for qualification testing:

(*a*) six complete assemblies of safety belts, including attachments, of each type and style to be qualified.

(*b*) three samples of webbing consisting of 4 yards each representing the lots of rolls of webbing to be used in the belts.

(*c*) one-fourth pound of thread on spool as used for stitching of the belts.
(*d*) two complete sets each of the hardware used.

4.2 Inspection and tests.

4.2.1 *Visual and dimensional inspection.*—Each of the sample belts and attachments selected in accordance with table I, shall be visually and dimensionally inspected by the Government inspector to verify compliance with this specification. Belts and attachments containing one or more defects, shall be rejected and if the number of the defective belts and attachements in the sample exceeds the acceptance number for that sample, the lot represented by the sample, shall be rejected.

4.2.2 *Lot acceptance tests.*—Each of the samples selected in accordance with table II shall be tested as specified in 4.3.3, 4.3.4, and 4.3.5, except that one-half of the number of samples selected shall be tested as specified in 4.3.3 and one-half as specified in 4.3.4 (the same belts being used for tests required in 4.3.4 and 4.3.5). Failure of any sample to pass tests specified herein shall be cause for rejection of the lot represented by the sample.

4.2.3 *Qualification tests.*—Qualification tests shall consist of those tests specified in 4.3 and the visual and dimensional inspection of 4.2.1. All sample belts submitted for qualification testing shall be inspected in accordance with 4.2.1. Three sample belts shall be tested as specified in 4.3.3 and three sample belts shall be tested as specified in 4.3.4 and 4.3.5. The selection of belts for test shall be made following the visual and dimensional inspection. Those sample safety belts selected and submitted in accordance with 4.1.4 shall be tested for qualification at a Government laboratory or a commercial testing laboratory as approved by the Standardization Division, Federal Supply Service, General Services Administration. Approval of a commercial testing laboratory for qualification testing shall be obtained from the Standardization Division prior to the tests. Application for approval shall include the following information:

(1) Name and location of laboratory.
(2) Extent of laboratory experience in the testing of this and other products.
(3) Statement that laboratory is equipped to make the tests listed above.

At the conclusion of the qualification tests in an approved commercial laboratory, copies of the test report certified by an executive of the manufacturing concern shall be submitted to the general Services Administration, FSS, Standardization Division.

4.3 Test procedures.

4.3.1 *General.*—Complete belts and attachments tested under 4.3 shall be in addition to the number specified for delivery in the contract or order. All complete belts and attachments subjected to test under 4.3 shall be destroyed upon completion of these tests. Tests shall be conducted under prevailing atmospheric conditions.

4.3.2 *Breaking strength test, webbing.*—Three samples of webbing, as used in the safety belts, shall be subjected to the following test: The samples shall be mounted in a testing machine when the heads are 10 inches apart and the heads shall separate at the rate of 4 inches per minute maximum under no-load. Each test sample of the webbing shall withstand a load at least equal to the minimum breaking strength specified in 3.4.1 for at least 3 seconds without failure.

4.3.3 Each of three identical samples of the safety belt assembly shall be tested to determine compliance with the strength requirements of 3.4.2. The belt length adjustment shall be positioned approximately halfway between the maximum and minimum length adjustment. The ends of the assembly shall be attached to the stationary and movable heads of the testing machine by means of adequate fittings, which will assure that all parts of the assembly are subjected to the load specified. It is intended that attachment to the heads of the testing machine shall simulate insofar as practicable the method of attachment to be used when the belt is installed in a vehicle. Part of the belt assembly which cannot, due to the design, be tested as part of the belt assembly, shall be individually tested in accordance with 4.3.3.1 to determine compliance with the requirements (see fig. 1 for suggested methods of attachment to the testing machine). The heads shall separate at the rate of 4 inches per minute maximum under no-load. The buckle shall be in locked position and the entire assembly shall be in axial alinement with the heads of the testing machine.

4.3.3.1 *Tensile strength test, common anchorages.*—Three identical samples of each part of the belt assembly, designed as a common anchorage, shall be tested as specified in 4.3.3, except that the belt webbing and buckle shall have

pieces of webbing or other suitable attachments substituted to determine compliance with the performance requirements of 3.4.2.1.

4.3.4 *Loop strength test, belt assembly.*—Each of three samples of the safety belt assembly shall be tested to determine the loop strength. The belt assembly shall be attached in the testing machine in a manner which will assure that all parts of the assembly are subjected to the load specified. It is intended that attachment to the heads of the testing machine shall simulate insofar as practicable the method of attachment to be used when the belt is installed in a vehicle. The belt assembly shall be adjusted to the same position as required in 4.3.3 and attached in the testing machine basically as shown in figure 2. (The belt shall be adjusted at the attachment point so that the buckle is midway of the overall length of the belt loop.) The buckle shall be closed and the belt passed over a test block. The test block shall be a 6-inch thick semicircular wooden form having a radius of not more than 8 inches. (See fig. 4.) The curved portion of the test form may provide a cutout to accommodate the belt buckle and may be padded to simulate a wearer's clothes. The heads of the testing machine shall separate at the rate of 4 inches per minute maximum under no load. Load shall be applied until the testing machine indicates the load specified in 3.4.3. (Examination of the belt for compliance with 3.4.3 shall be withheld until completion of the tests described below in 4.3.5.)

4.3.5 *Buckle release mechanism test.*—The belts used in the test of 4.3.4 shall also be used in this test. The load on the testing machine shall be reduced from the 5,700 pounds required in 4.3.4 to 250 pounds. The release mechanism of the buckle shall then be operable at no more than a 45-pound pull applied in the direction which would normally actuate the release. A small precision hand spring scale shall be used for this purpose. (See fig. 3.) The load shall be removed and the belt examined for compliance with the requirements of 3.4.4.

4.3.6 *Corrosion resistance test.*—Metal parts of the safety belt assembly shall be subjected to a salt spray (fog) test in accordance with ASTM B–117–54T for a period of 50 hours, consisting of 2 periods of 24 hours' exposure and 1 hour drying time each. Immediately after completion of this exposure and drying, the parts shall be examined for compliance with the requirements of 3.4.5.

4.3.7 *Color fastness, webbing.*—Color fastness of webbing for compliance with 3.4.6 shall be determined as follows:

4.3.7.1 *Color fastness to light test.*—Specimens of webbing shall be exposed for 20 standard fading hours, as specified in method 5660 of Federal Specification CCC–T–191, to determine compliance with the requirements of 3.4.6.

4.3.7.2 *Color fastness to laundering test.*—The webbing shall be tested in accordance with method 5614 of Federal Specification CCC–T–191, to determine compliance with the requirements of 3.4.6.

4.3.8 *Abrasion resistance test.*—The webbing shall be tested for abrasion resistance on the device shown schematically in figure 4. The webbing shall have a 5.2 pound$\pm$2 ounces weight attached to 1 end and the webbing shall pass over a hexagonal bar and be attached to the oscillating drum. The drum shall oscillate so that the webbing is given a 13-inch traverse over the bar at the rate of 60$\pm$2 strokes per minute. After 5,000 strokes, the webbing shall be removed and the breaking strength ascertained by testing as described in 4.3.2, to determine compliance with 3.4.7.

5. PREPARATION FOR DELIVERY

5.1 *Preservation, packaging, and packing.*—Applications for various levels of packaging and packing protection, shall be in accordance with Federal Standard 102.

5.1.1 *Packaging.*

5.1.1.1 *Level C.*—Belts shall be individually packaged with all necessary hardware and attachments for each style and shall conform to manufacturer's standard practice.

5.1.2 *Packing.*

5.1.2.1 *Level C.*—Belts shall be packed in standard commercial containers, so constructed as to insure acceptance by common or other carriers for safe transportation at the lowest applicable rate to the point of delivery.

5.2 *Marking.*

5.2.1 *Shipping containers.*—Shipping containers shall be marked in accordance with Federal Specification PPP–P–31.

6. NOTES

6.1 *Ordering data.*—Purchasers should exercise any desired options offered herein and should specify the following:

(*a*) Title, symbol, and date of this specification.
(*b*) Type (see 1.2.1).
(*c*) Style (see 1.2.2).
(*d*) Color, if different (see 3.3.2.1).
(*e*) Limitation in methods of attachment, where justified. (See Proposed Federal Standard No. 119, par. S3 (a) 1.)

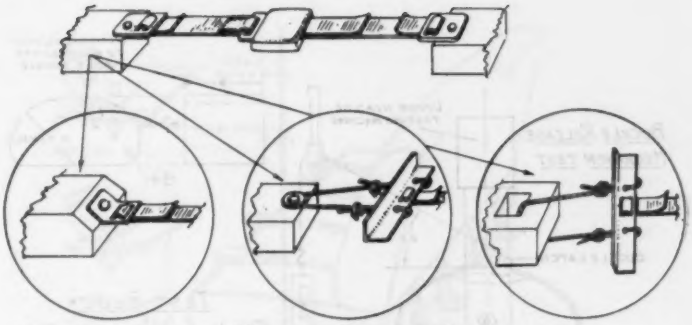
6.2 *Intended use.*—The automotive seat belts covered by this specification are intended for use in motor vehicles as an aid in reducing injuries and accidental death results from accidents.

6.3 In the procurement of products requiring qualification, the right is reserved to reject bids on products that have not been subjected to the required tests and found satisfactory for inclusion on the qualified products list. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products covered by this specification may be obtained from the Standardization Division, Federal Supply Service, General Services Administration, Washington, D. C.

6.4 Transportation description (to be furnished).

6.5 Dacron is the registered trademark of the E. I. duPont de Nemours Corp. for a polyester fiber.

Notice: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.



TENSILE STRENGTH TEST
(BELT ASSEMBLY)
SUGGESTED METHODS OF
ATTACHMENT TO TESTING MACHINE
FIGURE 1.

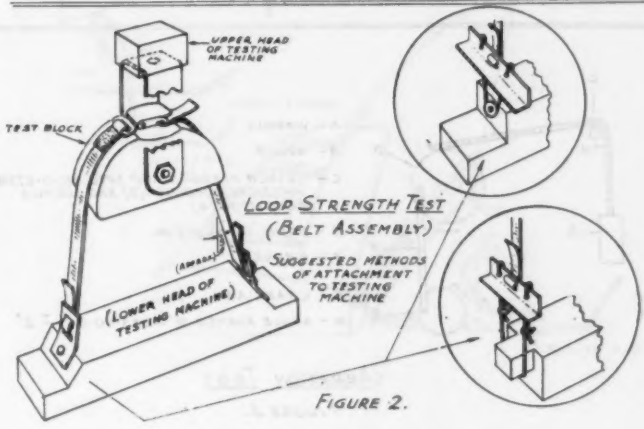

UPPER HEAD OF TESTING MACHINE
TEST BLOCK
(LOWER HEAD OF TESTING MACHINE)
LOOP STRENGTH TEST
(BELT ASSEMBLY)
SUGGESTED METHODS OF ATTACHMENT TO TESTING MACHINE

FIGURE 2.

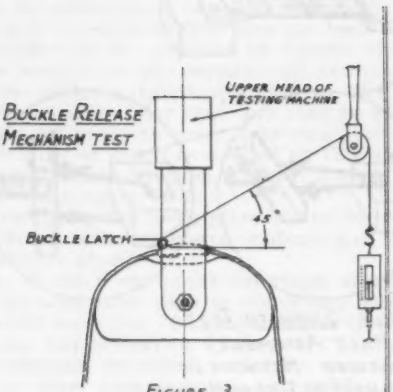
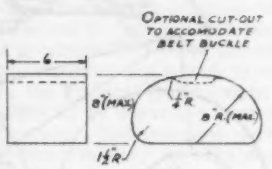
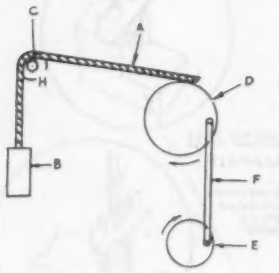


FIGURE 3



TEST BLOCK
FOR LOOP STRENGTH TEST

FIGURE 4.



A – WEBBING
B – WEIGHT
C – 1/4 INCH HEXAGON ROD SPEC. MIL-S-6758, PHYSICAL CONDITION (B) AND SURFACE CONDITION (4)
D – DRUM 16 INCH DIA.
E – CRANK
F – CRANK ARM
H – ANGLE FORMED BY WEBBING 85° ± 2°

ABRASION TEST
FIGURE 5.

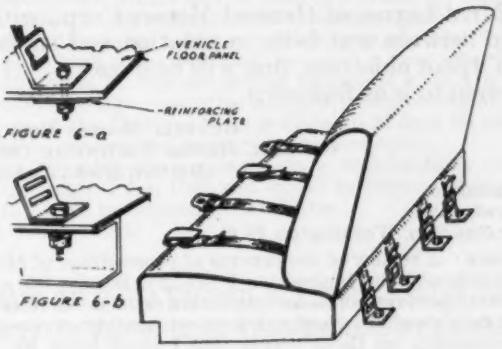


FIGURE 6

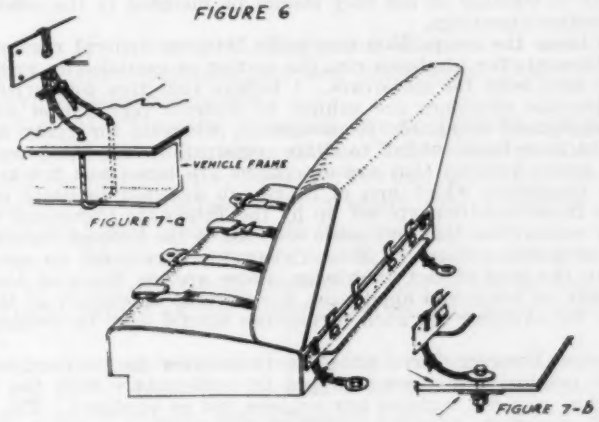


FIGURE 7

Mr. ROBERTS. I would like to say in that connection that practically all of the statements follow the same pattern—that it is felt that the belts in many cases save the lives of patrolmen and that most of them recommend the seat belt as making a very definite contribution to safety in automobile traffic.

Mr. Watson is here from GSA, and we will ask Mr. Watson to present the statement for Mr. Hanson at this time.

Mr. ROGERS. Before the witness proceeds, may I ask unanimous consent to insert in the record in connection with the testimony given by a representative of the automotive industry, a letter that will be furnished me by Mr. Chayne, of General Motors Corp., with relation to the relationship between seat belts in aviation and surface travel.

Mr. ROBERTS. Without objection, that will be done.

(The letter referred to is as follows:)

GENERAL MOTORS CORP.,
GENERAL MOTORS TECHNICAL CENTER,
Detroit, Mich., August 9, 1957.

HON. KENNETH A. ROBERTS,
House of Representatives,
House Office Building, Washington, D. C.

MY DEAR MR. ROBERTS: A review of the reports of proceedings of Monday's and Tuesday's meetings confirmed the impression I brought home with me Tuesday afternoon, that several important points in connection with the matter of Federal establishment of seat-belt standards had not been adequately covered. I should like to make some comments on these points and I shall leave up to you the decision as to whether or not they should be included in the official record of your committee's meetings.

Several times the comparison was made between Federal regulation of seat-belt requirements for airplanes and the matter of establishing Federal requirements for seat belts for motorcars. I believe that this comparison is not an apt one because airplanes are subject to Federal registration and therefore Federal equipment standards requirements; whereas, for many decades, passenger cars have been subject to State registration and equipment approvals. The only motor vehicles that are exceptions are buses and trucks engaged in interstate commerce, which are, of course, in addition to State requirements, subject to those requirements set up by the Interstate Commerce Commission.

Another comparison that was made referred to the Federal statute concerning locks on refrigerator doors. I submit that this to was not an apt comparison because, to the best of my knowledge, there are no State or local approval requirements on household appliances, nor is there machinery at the State and local level for carrying out such regulations should they be written into State laws.

The States, however, have adequate procedures for determining if motor vehicles as originally sold are equipped in conformance with the laws of the States. They will not register any vehicles not so equipped. The States, too, are staffed so that in accordance with their individual determination of needs they can insure that vehicles are kept in safe operating condition. Some of them handle this through inspections at regular intervals; whereas others may carry out this phase of their operations through spot checks, and still others may follow both procedures.

The State authorities have proven themselves to be extremely efficient in requiring high standards in such areas as lighting equipment and brake fluids. I mention these two because they are extremely important safety items upon which every owner has to rely in the use of his car.

At the present time, statutes referring to seat belts are on the books of eight States: California, Illinois, Michigan, New Hampshire, North Carolina, Pennsylvania, Virginia, and Washington.

I mentioned above the fact that the States are organized to insure that motor vehicles comply with their laws and I must point out that if any sort of Federal legislation is contemplated it will require the establishment of an organization which will be doing the same sort of work as the enforcement personnel in the various States but only in reference to one item. We have been told by the members of its staff that the ICC is seriously undermanned for the proper field

inspections necessary for the enforcement of its regulations concerning commercial vehicles used in interstate commerce.

It seems to the writer that we already have in the States' motor vehicle departments the organizations necessary for the establishment of adequate standards for seat belts and their attachments and for the proper enforcement of such statutes.

You will no doubt recall that upon the occasion of your visit to Detroit a year ago we had some discussions on the matter of the Uniform Vehicle Code and I would suggest that rather than to attempt to establish a Federal standard for seat belts and their attachments, your committee would be well advised to recommend to the National Committee on Uniform Traffic Laws and Ordinances that a section covering seat belts and their attachments be added to the Uniform Vehicle Code in order that it may be used as a model for legislation in the States. I would commend to your committee's attention pages III, IV, V, and VI of the booklet entitled "Uniform Vehicle Code," a copy of which I am forwarding with this letter, as I think these pages will give you a very clear picture of the exceptional qualifications of this committee to handle such a project. I might add that over the years this committee has proven its exceptional ability in keeping the provisions of the Uniform Vehicle Code up to date as knowledge and experience have made changes in the provisions necessary.

Since your committee is making such a conscientious study of this problem and its many facets, I felt that you would be interested in giving consideration to the points I have mentioned in this letter.

Very truly yours,

C. A. CHAYNE.

STATEMENT OF G. RAYMOND WATSON, ASSISTANT TO THE CHIEF OF SPECIFICATIONS AND STANDARDS, STANDARDIZATION DIVISION, GSA

Mr. WATSON. My name is R. Raymond Watson. I am Assistant to the Chief of the Specifications and Standards, Standardization, General Services Administration.

On behalf of Mr. Hanson, I would like to present the statement of Mr. John J. Hanson, Director of the Motor Equipment Division of the Federal Supply Service, General Services Administration.

Mr. ROBERTS. This statement is very short, and I suggest that you go ahead and read this statement, if you wish, sir.

Mr. WATSON. This statement of J. B. Hanson, Director, Motor Equipment Division of Supply Service, GSA, to the special subcommittee on traffic safety of the Committee on Interstate and Foreign Commerce.

Mr. Chairman, members of the Special Subcommittee on Traffic Safety, I am J. B. Hanson, Director, Motor Equipment Division, GSA. Our Administrator, Mr. Franklin Floete, wishes to express his appreciation to this committee for inviting GSA to be present at this hearing and to advise you that you have his wholehearted support in your undertaking to improve the safety of the operation of motor vehicles on the highways.

As you know, the Federal Government has more than a quarter million vehicles on the highways in this country and anything that can be done to reduce the accident bill will be a direct saving in taxpayers' money, as well as a greater saving in the reduction of human suffering.

This committee is to be congratulated on having in attendance many of the Nation's experts in this field. GSA believes that the value of automobile safety belts has been demonstrated by the results of the excellent studies conducted by the Cornell University and others

which undoubtedly have been or will be furnished to this committee by the other experts here.

Accordingly, we have no specific experimental data to offer. However, we also recognize that in some instances the safety belt has generated overconfidence or has become a trap. In other instances, cheap or improperly installed safety belts have failed in the time of need.

This is a big problem involved, getting people to use belts.

Accordingly, our position with respect to recommending seat belts throughout the Government service has been one of hopeful waiting, restrained by 2 factors which we consider serious obstructions to all out endorsement at this time. They are:

1. The inferior quality and dubious reliability of some seat belts and the insecure attachment to the vehicles in other instances; and
2. Riders' resistance to, or failure to use.

With respect to the first problem, GSA recognizes its responsibility to the Federal agencies to provide standards for belts and attachments which will assure that any belt procured for Government use is of top quality, is designed for proper attachment to the vehicle, and will not fail at the critical time. Accordingly, for some time our Standards Division has been working with other agencies and with representatives from industry to develop Federal specifications establishing minimum limitations for belts and attachments sold to the Government. We expect to have these specifications ready for publication this fall.

The second factor we feel is not so easy to solve. It has been our experience that car occupants, unless under enforceable orders, just won't or don't like to use seat belts. Limited testing on our part, substantiated by information from other experimental users, indicates that in those instances where belts have been made available, voluntary use is very slight.

Many people just don't like to bother with the belts. Others complain that the belts make them uncomfortable or restrict their freedom of movement. A more serious complaint from the fleet owners' viewpoint is: "The other fellow doesn't use the belt so he allows it to get greasy and dirty. Then, if it is used, the user's clothing becomes soiled and the user very unhappy." Along this line we also encountered numerous complaints of soiling or wrinkling of clothing or personal discomfort in hot weather.

One school of advocates believes that this condition can be cured by education. That of course remains to be proven. Other advocates say the answer is to devise ways to enforce use. But it is our experience that this also may not be so easy. There is also the contention, which must be given serious consideration, that if one life is saved for every 10,000 belts installed, the cost is cheap. But on the other hand, if belts are used by only a small percentage of the drivers, the question arises as to which group is the most accident prone and will the person who needs the belt be the one who is using it.

Consequently, our position is that seat belts properly installed and having a safe breaking strength have a safety value. The Federal Government is using several hundred on law-enforcement vehicles and some others on experimental basis on other vehicles. Our specifica-

tions will assure that belts purchased for these purposes will be a good quality and securely fastened.

However, since belts are only good to the extent they are used, we do not feel that, until reasonable usage can be expected, we are in a position to recommend the expenditure of 4 or 5 million dollars necessary to equip the other Federal passenger vehicles and commercial trucks being operated on the highways in this country.

Finally, we urge emphasis of the fact that, at their best, safety belts are but another safety device, and like all safety devices their value drops rapidly in proportion to increased speed.

We believe in the use of any safety device that will save lives, but belts, shoulder harness, crash helmets, safety glass, and other devices are all of little protection when vehicles are driven at excessively high speeds.

Gentlemen, in addition to adoption of any safety devices that have value, we urge serious attention to mandatory requirements for drivers' education and for enforcement of safe driving speeds. In our opinion, these are more essential than any safety device.

Mr. ROBERTS. Thank you.

Any questions?

Mr. ROGERS. I want to ask Mr. Watson some questions.

You make the statement it will cost 4 or 5 million dollars. Is that what you estimate the cost would be to put seat belts on Government vehicles?

Mr. WATSON. Yes, sir.

Mr. ROGERS. Does that include all Federal vehicles?

Mr. WATSON. That, sir, would include—it is predicated upon equipping all Federal vehicles; yes, sir.

Mr. ROGERS. That is all Federal vehicles in every area?

Mr. WATSON. The figures as prepared by Mr. Hanson were predicated upon the quarter million vehicles now operated by the Government.

Mr. ROGERS. That includes the entire United States?

Mr. WATSON. Yes, sir.

Mr. ROGERS. Does that include those vehicles which are driven by a man in Government service who has to make frequent departures to and from his vehicle?

Mr. WATSON. I believe, sir, that is taken into consideration. I think you have in mind the postal workers for one?

Mr. ROGERS. Yes, where they have to make repeated stops.

Mr. WATSON. That is taken care of. I cannot answer directly on that. I would say only this, that that is a problem that has been considered as to whether it should be used or not.

Mr. ROGERS. Do you have an estimate as to the number of man-hours that would be lost by those people who have to make frequent departures from the vehicle, with relation to putting on the seat belts and then unbuckling them every time they get in and out of the car?

Mr. WATSON. I don't have the figures, but I do know, for instance, the Post Office Department has made a study of that situation and it takes a considerable number of hours, it is true.

Mr. ROGERS. Does it take into consideration those operations in which a man operates his automobile where he is standing up?

Mr. WATSON. That has, also, been considered in this study.

Mr. ROGERS. What kind of belt would be on him?

Mr. WATSON. That is a problem which has not been solved.

Mr. ROGERS. Mr. Watson, let me ask you this: you are advocating the use of seat belts on cars driven in the cities as well as in the long-range driving?

Mr. WATSON. That is correct.

Mr. ROGERS. That is in Washington, for instance?

Mr. WATSON. We are advocating the use of the seat belts only following the correction of these two, not objections but waivers, shall we say, wherein we get a good quality belt and when we can overcome the rider's resistance to their use, were installed.

Mr. ROGERS. Well, so far as the Government departments are concerned, you have quite a bit of latitude in the Government departments, I mean, as to orders, rules, and regulations governing the employees within the departments and agencies, do you not?

Mr. WATSON. Yes, that is right.

Mr. ROGERS. As a matter of fact, you can require them to use seat belts, and if they do not they could even charge them with demerits under civil service, could they not?

Mr. WATSON. That is right.

Mr. ROGERS. In other words, you can pass the laws relating to making it enforcible?

Mr. WATSON. Yes, sir. That would be something which would be based on an internal decision within the areas, I assume, and also based on education of the person using the belts.

Mr. ROGERS. As to the quality of the seat belt, of course, you are taking into consideration the fact that any seat belt, in order to be effective, would have to be particularly good, to answer the purpose for which it was put on the automobile?

Mr. WATSON. Yes, sir.

Mr. ROGERS. Mr. Watson, are you in a position to state whether or not GSA is advocating the passage of legislation requiring motor vehicles operated by the Federal Government to be equipped with seat belts?

Mr. WATSON. No, sir. That is not the intent at this time.

Mr. ROGERS. You are speaking of the policy of the GSA?

Mr. WATSON. That is right. It is not their intention at this time to advocate such legislation.

Mr. ROGERS. Have they stated a position with regard to the use of seat belts on all automobiles by Federal legislation having to do with it?

Mr. WATSON. Not to my knowledge.

Mr. ROGERS. In other words, your testimony is confined merely to the Federal operation that you have stated?

Mr. WATSON. That is correct, particularly in my particular case it has to do with providing suitable documents whereby those who find that seat belts are needed, in their operations, can be obtained.

Mr. ROGERS. Now in making this estimate you include seat belts for all seats?

Mr. WATSON. I believe I cannot state exactly how those figures were arrived at, inasmuch as they were done by Mr. Hanson in the Motor Equipment Division. I would assume, though, that the figures would be to provide belts for those occupants that normally occupy the car—

such as we have certain vehicles that operate and carry passengers, I assume they would have provided belts for all—there is not more usually than the driver and one occupant on the front seat normally.

Mr. ROGERS. In the bus service, I see lots of them coming up in the morning, interagency pool, what about those?

Mr. WATSON. I cannot answer whether or not that was provided for, but I would assume that it has been. I would assume that it is in the figures. I cannot state positively.

Mr. ROGERS. That is all.

Mr. ROBERTS. We have three more witnesses. We have one witness who is here from California, and another one from New York, and the House meets at 11 o'clock. I would appreciate very much if the members would bear that in mind.

Mr. SCHENCK. No questions.

Mr. LOSER. No questions.

Mr. ROBERTS. The next witness is Mr. Severy. Will you come forward. We will be glad to hear you at this time.

STATEMENT OF DERWYN M. SEVERY, THE INSTITUTE OF TRANSPORTATION AND TRAFFIC ENGINEERING, UNIVERSITY OF CALIFORNIA (LOS ANGELES)

Mr. SEVERY. Mr. Chairman, I should like to present a statement prepared jointly by me, Prof. J. H. Mathewson, and Mr. Arnold Siegel, my two principal associates in our automobile collision injury research.

In 1949 our organization, the Institute of Transportation and Traffic Engineering—established by California State Legislature in 1947—of the University of California, embarked upon a program of automobile crash injury research.

In one of our early attempts to secure basic information on the forces of deceleration that prevail during a crash, we saw fit to join with organized stunt drivers in that we instrumented cars which they were preparing to use in staged head-on collisions. While we learned a great deal and received splendid cooperation from both management and drivers, we were eventually forced to the conclusion that the demands of the audience and our research requirements were incompatible.

We then went solely on our own resources even though this meant slower progress. With the cooperation of the Los Angeles Police Department we made independent investigations of traffic accidents at the scenes of the accidents. Here again we learned a great deal but there were always categories of information that were unobtainable, or if obtainable, did not meet adequately the validation requirements of our research objectives.

For example, it will be readily recognized that speed, or in the case of two or more cars, speeds at the instant of impact cannot be accurately determined in the majority of accidents. To further confound the problem there are, in many instances, secondary impacts or collisions. In order to avoid such imponderables we decided to conduct our own collisions under controlled conditions we could not obtain otherwise.

Our research objectives pertinent to the subject on which we were requested to testify included, (1) determination of the force systems

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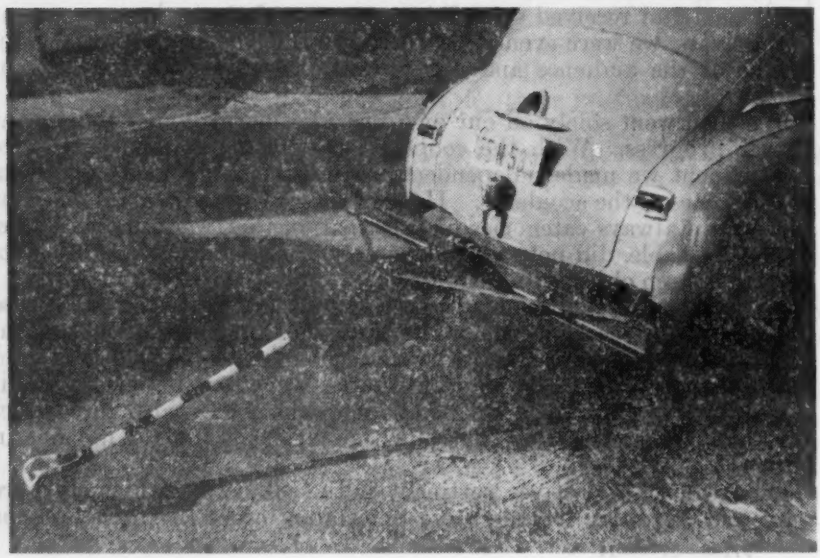
applied to human occupants during collision, i. e., rate of onset of deceleration, miximum deceleration, and duration of the deceleration period, all related to the several vital parts of the anatomy; (2) evaluation of the forward interior surfaces of the motorist compartment with respect to their injury-producing potential; (3) determination of the kinematic behavior of car occupants for fixed obstacle, rear-end, head-on, and oblique collisions, for variations in position of occupants within the car, vehicle type, and impact velocity; (4) procurement of motion-picture films of the dynamical features of collision decelerations for both car and occupants for review and analysis by engineers; (5) determination of the deceleration rates of the principal sections of the automobile during collision and particularly the deceleration rates of the passenger compartment; (6) determination of the mechanism of collapse for the structural members forward of the firewall during frontal collisions, and determination of magnitudes of and relationships between longitudinal, vertical, and rotational accelerations; (7) development and presentation of driver education information for use by secondary schools and other agencies concerned with driver education and training.

(NOTE.—An illustration in the last-mentioned area may be cited in the form of an institute-developed sound motion picture on automobile collisions and seat belts. The University of California will shortly make this film available for distribution throughout the United States on both a purchase and rental basis—see attachment No. 1 at the end of the report.)

Mr. SEVERY. In our first completely controlled experiment, the primary objective was to evaluate the effectiveness of a chest-level safety belt under moderately severe rates of deceleration. A human subject was used in this series of nondestructive experiments. Figure 1 shows the tail-hook assembly on the rear of the car.

(Figure 1 is as follows:)

FIGURE 1



Mr. SEVERY. Figure 2 shows the car on a run immediately after the tail hook engaged the cable connecting the four 1-ton sled-type drag blocks.

(Figure 2 is as follows:)

FIGURE 2

Mr. SEVERY. In general, the experiment was successful, but we were unable to reach the deceleration levels commonly encountered in automobile collisions. Consequently, we concluded that further experiments using the drag-block, arresting-gear method were not warranted.

Our next experiment, and I am referring to the year 1952, consisted of crashing an instrumented car into an essentially nonyielding barrier. This experiment was the first of a series designed to evaluate the protective or restraining features of automobile lap-type belts, chest-type and shoulder-type belts or harnesses, as well as to facilitate engineering analysis of the collapse characteristics of an automobile structure on severe impact. The objective in the analysis was to uncover information that might lead to the design of automobiles with improved progressive-collapse characteristics.

The automobile used in this first completely controlled experiment was a 1937 Plymouth which had been instrumented with mechanical and electrical accelerometers and electrical strain gages. An anthropometric dummy was secured by a chest-type safety belt to a seat, with both dummy and seat instrumented.

The crash car was accelerated by pushing, guided by remote control, and allowed to coast into a fixed barrier. The barrier was constructed of large-diameter utility poles backed up by dirt so as to provide an essentially nonyielding wall.

A high-speed, motion-picture camera and several accessory movie cameras were directed at the point of impact. The instrumented or crash car was suitably calibrated with visual markers to facilitate accurate evalution of the deceleration pattern of the car during impact through subsequent film analysis.

The first impact test was made at approximately 10 miles per hour with a human subject as well as the dummy in the car. Both the subject and dummy were restrained by safety belts which passed hori-

zontally across their chests and under their arms to rigid anchorages behind them. The belts were made of 3-inch nylon webbing attached to 40–G hardware.

In the interest of safety, it was considered inadvisable to use a human subject at higher speed. The test to destruction was executed at a speed of 25 miles per hour. The dummy sustained some damage to the neck and arms at the peak deceleration of approximately 24 G, but the failures were essentially those associated with construction details not corrected during the dummy's modification for these tests. The restraining device gave satisfactory performance.

The barrier-impact technique provides a practical means for studying the reactions of automobiles and motorists under destructive impact conditions. For the particular car used in the test, the bumper and its fastenings were crushed in a distance of 12 inches without absorbing any significant amount of energy. The frame of the car absorbed on impact less than a fourth of the car's kinetic energy. The deceleration pattern indicated a higher G loading than there would have been if the automobile design had provided energy absorption upon impact by the progressive collapse, that is, optimum force moderation, of the forward structure.

THE ANTHROPOMETRIC DUMMY

The phase of this research project concerning the development and evaluation of devices appropriate for restraining the motorist against the effects of crash deceleration suggested the need for a test dummy. This seemed advisable, owing to the small amount of information known about the deceleration pattern of the crashing automobile and the effects of such force systems on the human body secured by restraints of new design. Eventual evaluation of the voluntary limits of such protective devices must, of course, be made by human subjects, possibly preceded by tests made on live animals having anatomy comparable to that of the human body, for example, apes.

The anthropometric dummy developed by the Institute of Transportation and Traffic Engineering, University of California, will be referred to for simplicity as ITTED. In addition to the requirement that this dummy should have the physical appearance of man, it was considered necessary that it should have a total weight comparable to that of man, and that the distribution of this weight among the various components of the body follow that of man. It was further considered essential that the weight distribution among the various component parts of the body be adjusted so that the center of gravity of each body segment approximate that of man. The specifications used in determining these factors were based on the cadaver studies by Braume and Fischer. A final specification was that this dummy

possess a degree of joint fixation in the principal joints of the body which approximates that of an average-strength individual alerted to an impending crash.

Such additional refinements as the provision of tissue compressibility and tissue resiliency, as well as muscle return, could not be incorporated in this experimental model, since this would involve the expenditure of time and funds in excess of practical limits.

TEST SITE AND BARRIER

Because of the hazardous and unusual nature of this investigation, it was necessary to secure the use of a test site which was located in an unpopulated, fenced-in section having a roadway at least 800 feet long. Arrangements were made with the Los Angeles Department of Water and Power to use a portion of its facilities at the valley steam plant. This department also prepared the necessary dirt roadway and constructed a barrier at one end of the road.

The barrier was inspected directly following the high-speed impact. There was no indication of significant displacement of the barrier. The timber retained a deformation of approximately one-fourth inch in several small areas. Although there was no doubt that significant energy was absorbed upon impact, it seems reasonable to conclude that the severity of the collision was not reduced significantly by yielding of the barrier.

The test site is shown diagrammatically in figure 3, and the barrier shown photographically in figure 4.

(Fig. 3 is as follows:)

FIGURE 3

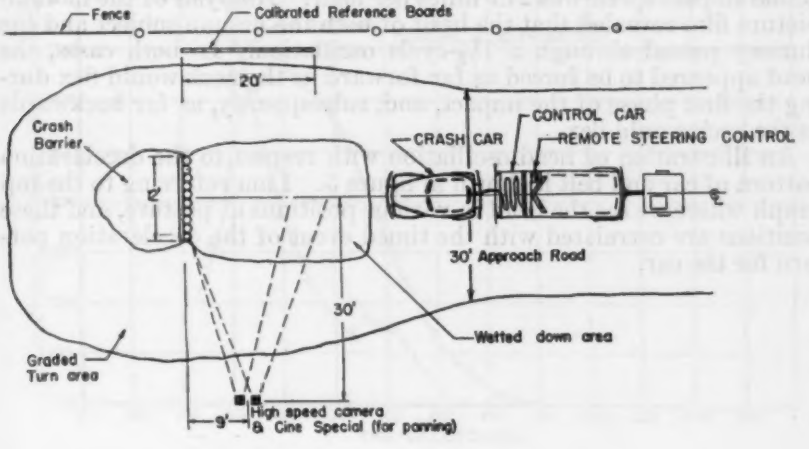
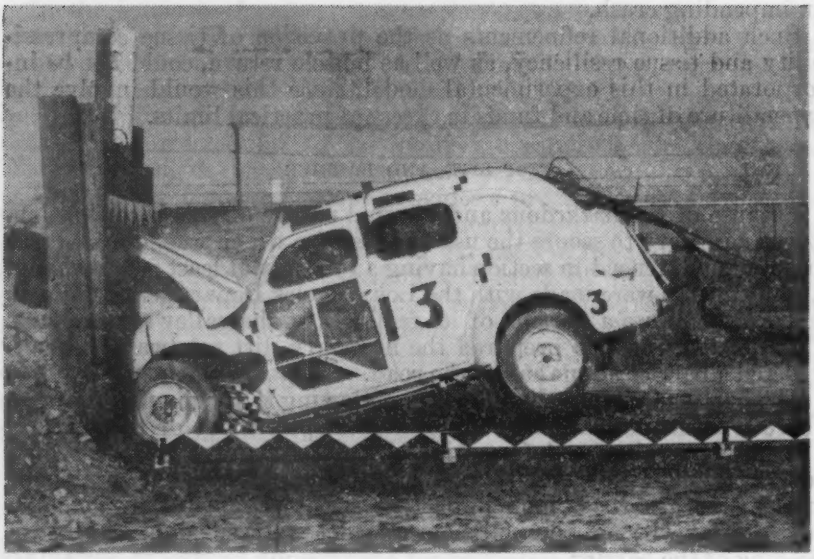


Fig. 4 is as follows:)

FIGURE 4



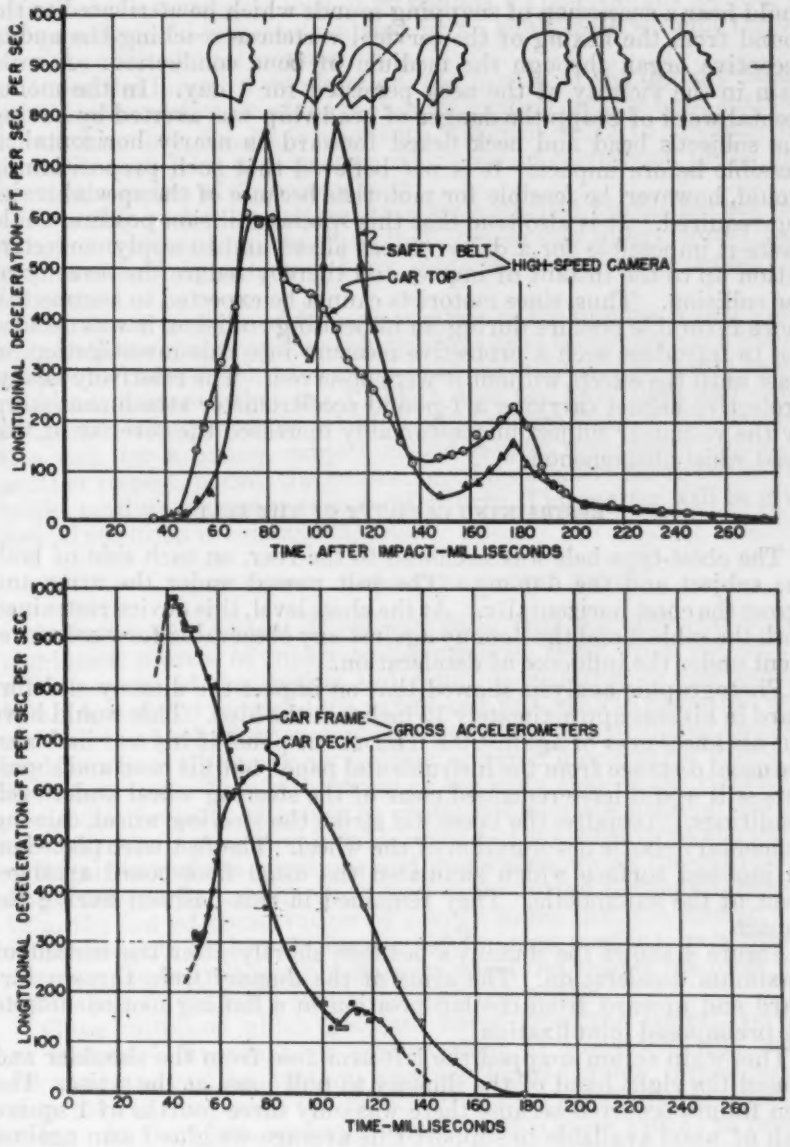
HEAD OSCILLATIONS AND OTHER RESPONSES OF THE BODY TO CRASH DECELERATION UNDER RESTRAINED CONDITIONS

Mr. SEVERY. The planned impact speed was 25 miles per hour. The actual impact speed was 24.9 miles per hour. Analysis of the motion-picture film revealed that the head of both the human subject and the dummy passed through a 1½-cycle oscillation. In both cases, the head appeared to be forced as far forward as the neck would flex during the first phase of the impact, and, subsequently, as far backwards as the neck would flex.

An illustration of head oscillation with respect to the decelaration pattern of car and belt is shown in figure 5. I am referring to the top graph where we see the head in various positions of posture, and these positions are correlated with the timed event of the deceleration pattern for the car.

(Fig. 5 is as follows:)

FIGURE 5



Mr. Severy. In the human test the subject reported that during the low-velocity impact his head whipped forward so abruptly that he could hear a succession of snapping sounds which he attributed to the sound from the flexing of the cervical vertebrae reaching the audio-receptive organ through the medium of bone conduction. A mild pain in the vicinity of the neck persisted for 1 day. In the monumental work of Stapp the danger of headwhip was averted by having the subject's head and neck flexed forward as nearly horizontal as possible before impact. It is not believed that such prepositioning would, however, be feasible for motorists because of the special training required. It is also true that this special collision posture would make it impossible for a driver to see ahead and to apply corrective action up to the instant of impact and thereby reduce the severity of the collision. Thus, since motorists cannot be expected to assume this more favorable posture during an impending collision, it was decided not to introduce such a protective measure into this investigation, at least until the effects without it were observed. The relatively heavy, protective helmet carrying a 1-pound accelerometer attachment worn by the volunteer subject unquestionably increased the severity of this head-whip phenomenon.

RESTRAINING CAPACITY OF THE BELT

The chest-type belt was anchored to the rear, on each side of both the subject and the dummy. The belt passed under the arms and across the chest horizontally. At the chest level, this device restrained both the subject and the dummy against any observable forward movement under the influence of deceleration.

Photographic analysis showed that on impact the dummy slid forward in his seat approximately 12 inches at the hips. This would have put his knees near or against the instrument panel if his seat had been the usual distance from the instrumental panel, but his head and shoulders still would have remained clear of the steering wheel under such conditions. Actually, the knees did strike the steering wheel, causing momentary elastic deformation of the wheel. The feet were placed on an inclined surface which simulated the usual floor-board arrangement of the automobile. They remained in this position during the impact.

Figure 4 shows the dummy's position shortly after the instant of maximum deceleration. The arms of the dummy were thrown forward and upward from the lap position in a flailing motion despite the preimposed joint fixation.

This whip action snapped the left arm free from the shoulder and caused the right hand of the dummy to pull loose at the wrist. The arm failure occurred because there was only three-fourths of 1 square inch of wood available to support this average weighted arm against the combined effects of deceleration, which increased the effective weight of the arm on the order of 20 times, and the bending moment at the shoulder which developed due to the preimposed joint fixation.

In the case of the dummy's hand, the spring-loaded ballpin locking device should have been replaced by a positive locking device to make it correspond more closely to the strength of its human counterpart.

Although there is experimental evidence that human arms do not tear loose from decelerations far in excess of 20 G, the arm of the

dummy which remained intact was tested to destruction experimentally. Static loading designed to approximate the dynamic conditions of the barrier impact produced failure for a longitudinal load of 103 pounds and a transverse load of 90 pounds. The resultant loading of 137 pounds could be accommodated by an adult male without the occurrence of accidental amputation.

Under the forces of deceleration, the inertia of the dummy's head overcame the resistance of the neck-joint fixation and the head snapped forward against the limit pad with sufficient force to fracture the dummy's neck joint at a location which would correspond to the first thoracic vertebra of the human body.

Since this neck joint had not been strengthened for the impact test, it is not reasonable to conclude that comparable injury would have been sustained by a human body subjected to the same decelerated pattern.

There were no signs of damage or strain to the dummy which would suggest that a corresponding injury might have taken place if a human subject had been decelerated in place of the dummy. It should be emphasized, however, that the ITTED does not have flesh and chest-compressibility properties which tend to reduce slightly the deceleration rate for a human subject in one respect, but which would, in another respect, permit the generation of destructive shear forces that might produce serious or even fatal injury. This matter will be given special attention in subsequent tests.

LAP VERSUS CHEST-TYPE SAFETY BELTS

A review of Accident Facts will show that the only statistically significant sources of injury to the motorist result from collision or other sources of destructive and rapid deceleration of the automobile. A motorist secured by a safety belt in a vehicle under the usual conditions of vehicular motion, can have only one principal reactionary force prevail during an accident or rapid deceleration which can be anticipated. This is the force of the body against the restraining device as the body attempts to continue along the original path of motion under a condition in which this motion is being decelerated.

Regardless of the gyrations and distortions which the automobile, and consequently its occupants, may suffer during accidental deceleration, the law of conservation of energy states that the human body must dissipate its kinetic energy (of forward motion) by a reactive force on the body through a distance which represents the total work equivalent to the body energy of forward motion.

Those collisions which generate forces from the lateral, vertical, or rearward directions, or combinations of these with the known forward restraining vectors, produce unpredictable forces because they do not exist until the peculiarities of a particular accident develop. It, therefore, seems unrealistic at this point (1953) to develop specialized protective passenger restraints to counteract any but the most frequently encountered force, namely that which restrains the motorist from being thrown against the forward surfaces of the car's interior or, in that general direction, through open doors or through the windshield.

For the average front seat, the lap-type safety belt provides this protection only for the less vulnerable portion of the anatomy, leaving the vital parts, particularly the head, to destructive deceleration. The chest-type safety belt, while not the final solution to this problem, does provide effective restraint against the only predictable forces of deceleration which can develop during the accident, namely, those which tend to decelerate both the car and the motorist.

A common category of accidents are those in which a relatively minor oblique impact from the opposing vehicle or fixed object results in superficial damage to the car.

In such accidents, however, the initial impact serves to disorient the driver, causing him to lose control of the car, so that a secondary and frequently severe collision occurs. Circumstances such as these suggest that a properly designed motorist-restraining device should keep the driver and other occupants in their normal seated positions within the car in order to: (1) Prevent vital parts of the anatomy from being subjected to injurious impact; (2) prevent the driver and passengers from being thrown from the car; and (3) guard against loss of control of the car following impact.

A simplified shoulder harness has been tested and shows promise of providing a more effective restraint and of overcoming some of the objectionable features of a chest-level belt.

Our findings and conclusions in the above-described test were stated in part as follows:

1. This study represented, as far as can be determined by the authors, the initial test of a motorist-restraining device by experimental collision techniques. The results were, therefore, regarded as approximate until other tests had been conducted to substantiate these findings.

2. The barrier-type impact test provides a practical and realistic means of studying the performance of automobiles and the effectiveness of motorist-restraining devises under crash conditions. The barrier appears to impose a more-severe test for motorist-restraining devices than does the head-on collision-type impact for comparable preimpact conditions.

3. When a motorist driving 25 miles per hour is effectively restrained by a safety belt, he could experience a maximum rate of deceleration as low as 25 G's during impact even with a nonpenetrating fixed object, such as the barrier used in this test.

Since deceleration rates in excess of 40 G's have been voluntarily tolerated, the problem of avoiding injury from accidents with this degree of severity appears to be one of developing an adequate restraining device which will meet with the approval of the motoring public and which, of itself, will not cause injury.

4. While the results of this test are not conclusive in terms of human responses, the postcollision evaluation of the damage to the dummy suggests the improbability of any serious injury had a human subject wearing a similar chest belt been decelerated in place of the dummy.

Observation of film from the high-speed camera showed that on impact the dummy shifted forward about 12 inches from the waist down. This movement placed the chest belt high across the sternum, causing it to press upward under the arms. This shift, which occurs

during impact, appears to be advantageous, since it places much of the load on the stronger shoulder skeletal structure, rather than only on the rib cage.

5. For this test—this is the 25-mile-an-hour barrier collision that we are referring to now—the rate of onset of deceleration for the dummy was 595 G's per second and the dummy was exposed to a maximum deceleration of 24 G's. The overall deceleration period was 250 milliseconds. These values are substantially below the voluntary tolerance limit for the human being, as determined by Stapp.

6. The chest-level safety belt is an effective means for restraining the body against the forces of impact which, in the absence of such a device, would result in the body being hurled against the forward surfaces of the car's interior. However, the possibility of injury resulting from (1) an excessive compressive loading of the chest; (2) an acute flexure of the spine; and (3) an extreme excursion of the head; that is, "whiplash," cannot be overlooked and is currently being investigated.

7. The vertical acceleration of the car-body structure during head-on and barrier impacts showed no tendency in this test to disorient the dummy relative to the horizontal chest-level belt.

Observations based on this test do not support the belief of some observers that this vertical acceleration would disorient the motorist relative to the chest-level safety belt and cause it to apply a restraining force to some less favorable part of the anatomy, such as the abdomen. Both a head-on and barrier-type collision have thus far revealed maximum vertical accelerations amounting to less than 2 G. Accelerations of this magnitude have no significant influence toward belt-body disorientation when, as for the conditions of this test, the body is loading the belt more than 10 times this amount as a result of forward deceleration.

8. Without overlooking the benefits which may be derived from the use of a lap-type belt for rear-seat occupants in cases where there is sufficient forward clearance, it would appear that if the front-seat injury and death toll is to be reduced appreciably, a device which effectively restrains the head and chest, as demonstrated in this test, must be provided.

Even with a lap belt, the out-thrust arms cannot be expected to resist the forward forces of the upper torso, which exceeded 2,000 pounds in the 25-mile-per-hour impact. This is in reference to a 175-pound adult.

For front-seat usage, the lap-type belt provides impact protection only for the less vulnerable portions of the anatomy, leaving the vital parts (head and upper torso) exposed to gross destructive deceleration.

9. A properly designed motorist-restraining device should: (1) Restrain the body in such a manner as to prevent the vital parts of the anatomy from being subjected to injurious impact, (2) maintain driver and occupants in their proper seated position in order to prevent loss of control of the car following impact. Incidentally, the lap belt is very effective in this respect as well as to—(3) prevent driver and passengers from being thrown from the car and being injured or killed (*a*) by impact with fixed objects, (*b*) by crushing by their own vehicle, or (*c*) crushing by other vehicles.

10. The bumper collapsed completely during impact without contributing significantly to the deceleration of the car. (Recent experiments show some new cars to have improved bumper collision performance.)

11. Under the stresses of severe impact, the automobile responds as a somewhat flexible structure. A previous head-on impact study as well as the barrier-type impact study indicate that the intact portions of the car frame may reach peak rates of deceleration somewhat higher than the adjacent upper parts of the automobile body. Further study of this phenomenon should provide data suggesting the structural member of the car most suitable for securing the anchorages for restraining devices. Incidentally, many of these statements are from previously published studies but we find that we have no conflict with the findings in subsequent studies and this is true, for example, with respect to the anchorage problem. We have found no objection to anchoring seat belts to the floor panel.

12. The deceleration pattern of the crashing car suggests that the severity of a crash would be reduced significantly if the frame of the car was designed with an energy-absorbing section capable of reducing the peak deceleration by about 30 percent. To what extent, if any, this problem has been met in automobiles of more recent design than the test car used are being evaluated in subsequent tests.

13. Calculations based on this crash test indicate that the frame of this car absorbed appreciably less than 42 percent of the preimpact kinetic energy. As an estimate, not more than a third of the preimpact kinetic energy was absorbed by the frame of the car.

14. The deformation pattern of the test-car frame appears to be triangular, with maximum deformation occurring at the bumper and decreasing nearly linearly from the front section of the frame toward the firewall. Additional investigation is necessary to determine to what extent this pattern deviates from an ideal collapse pattern, as well as the extent to which late-model cars deviate from the ideal.

15. In the past, the coefficient of restitution for the crashing automobile was estimated as being nearly zero. The coefficient of restitution for the automobile-barrier impact was 0.16. The coefficient of restitution for 2 head-on collision studies were 0.03 and 0.10. These coefficients are valuable in problems concerning the calculation of the estimated preimpact speed of vehicles.

Analysis of subsequently conducted barrier collisions yielded the quantitative and qualitative data shown in tables 1 and 2. In all, the dynamics of the human body during collision phenomena were determined for five conditions of restraint—one being no restraining devices whatsoever.

Four restraint configurations were evaluated from data obtained in barrier collisions. The fifth restraint, a combination of lap-type belt and shoulder loop, was used by a human subject in a 25-miles-per-hour, rear-end collision with a stationary car.

(Tables 1 and 2 are as follows:)

TABLE 1.—*Performance of 3 belt configurations*

Restraint configuration	Peak force (pounds)	Belt stress duration in seconds	Force-time units	Relative restraining effectiveness [1]	Remarks
Chest	1,735	0.105	2,300	100	The chest belt dissipates a greater amount of body-crash energy than the other (see below) 2 units without increasing the peak stress to the body. Physiological considerations are discussed elsewhere.
Lap	1,725	.057	[2] 1,500	77	The lap belt is a somewhat less efficient restraining device for front-seat occupancy and for the front-end impact situation. It does not prevent the head and upper torso from striking the forward surfaces of the car interior. Energy is then absorbed from the most vital parts of the anatomy by injury-producing mechanisms.
Shoulder loop	1,735	.143	1,550	68	The shoulder belt dissipates the least amount of body-crash energy. However, it maximizes (for a single restraint) the protection of the most vital parts of the anatomy, the head and trunk.

[1] The area under the force-time curves given in units by this table provides an index of the relative restraining effectiveness of each configuration. For ease of comparison, these values are divided by a constant to make the most efficient equal to 100. Consideration was given to the fact that lap- and chest-belt tensiometers were arranged in parallel so that their force-time values were additive while the shoulder-belt tensiometers were arranged in series so that their values were averaged.

[2] This value must be corrected by the factor 200/170 to account for weight differences of dummies before determining the relative restraining effectiveness of the lap belt.

TABLE 2.—*Crash injury findings, auto barrier impact (classes of injuries: Minor, moderate, severe, serious, critical)*

Car	Dummy	Forces on safety belt (pounds)[1]	Deceleration of dummy	Inferred injuries[2]			
				Head	Trunk	Arms	Legs
No. 2, 26 miles per hour.	ITTED—Front-seat passenger (wearing no belt); probable fatality.	(3)	Head: Calculated mean deceleration in excess of 200 *G*.	Critical—Scattered abrasions: contusions around mouth, frontal skull and over occiput. Probable concussion. Fractured and lacerated nose. Combined injuries probably fatal.	Critical—Contusions and superficial abrasions over anterior midchest wall, probably a major crushing injury of chest because the instruments on chest were crushed: multiple contusion around pelvis.	Moderate—Abrasions right shoulder, lacerations left arm, upper and lower laterally: contusion right wrist. Laceration right hand, laterally and superiorly.	Critical—Left leg disarticulated at hip joint. Both knees disarticulated. Marked contusions with scattered abrasions right med. lateral thigh, left med. thigh and inguinal region medially: contusions below left knee and right knee.
	SED—Driver (wearing shoulder loop belt) survived.	1,735	(3)----------	Minor—Multiple abrasions. Minor contusions around nose, right eyebrow, around left earlobe, and chin. Other multiple small abrasions about head.	Minor—Contusion mid-anterior chest wall (head snapped forward, driving chin into chest).	Minor—Few scattered abrasions both hands.	Moderate—Abrasion contusion left hip: deep laceration about 2 inches down to the bone in left upper medial leg just below knee joint—leg struck remote steering bracket.
No. 3, impact velocity, 29 miles per hour.	ITTED—Front-seat passenger (wearing lap belt); probable fatality.	1,725	(3)----------	Critical—Multiple abrasions; contusions over entire forehead, nose, chin, frontal scalp (probable concussion), and occiput, neck and ears. Laceration right eyebrow; neck and head of model severed from model's body; inferred probable fracture of cervical spine.	Critical—Scattered abrasions; contusions upper anterior and right lateral chest wall; small contusion right shoulder; multiple contusions and abrasions lower anterior abdominal wall around pelvis; marked abnormal lordotic curve of thoracolumbar joint of model; inferred fractures of thoracolumbar spine.	Serious—Right arm dislocated from model at elbow joint; inferred probable fractures of right elbow joint. Right hand broken through midpalm, inferred multiple fractures of metacarpals, contusional right and left wrist. Fracture of left thumb.	Critical—Both hips disarticulated from model; inferred bilateral fractures through neck of femur (bilateral). Severe contusion, laceration right lateral mid-thigh, inferred fracture mid-shaft right femur, multiple contusions left thigh anteriorly and posteriorly, left knee joint disarticulated from model; inferred fractures around right knee joint. Scattered contusions both ankles.

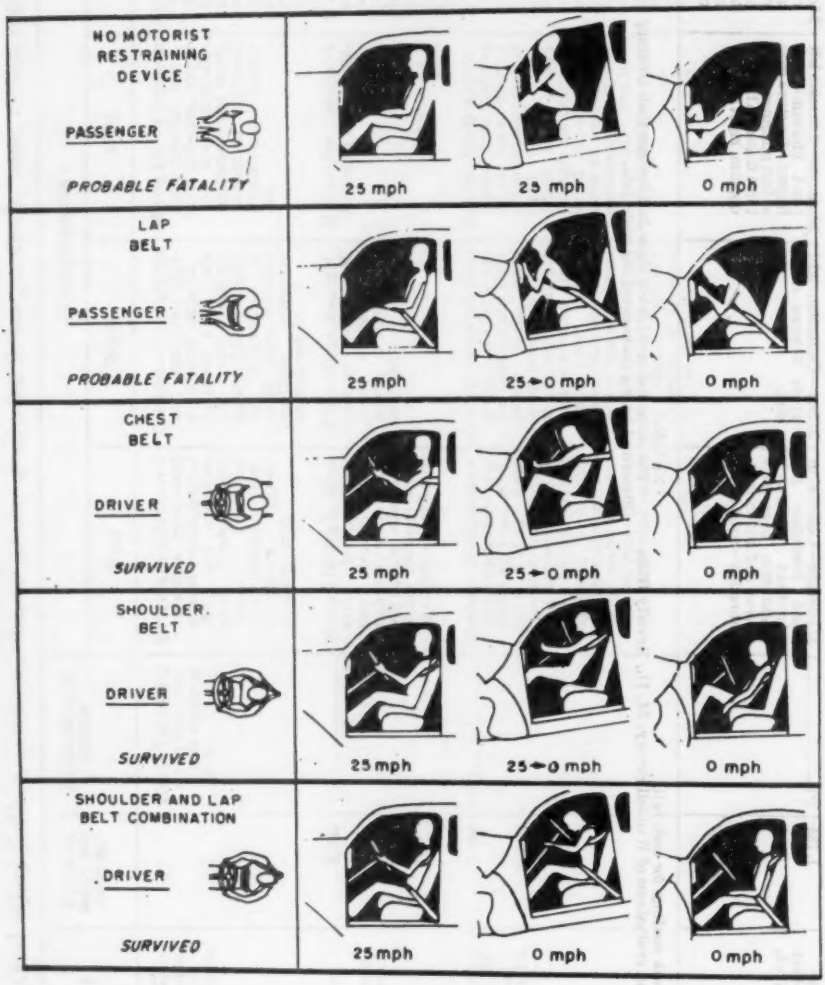
SED—Driver (wearing chest belt) survived.	1.735	(4)	Moderate—Contusion and laceration left forehead (eyebrow), contusion over posterior and midocciput, abrasion—right ear.	Minor—Contusion right upper anterior chest wall.	Moderate—Abrasion left hand (dorsum) and fingers. Fracture base of first phalange, right third finger. Abrasion dorsum, right hand.	Moderate—Abrasions, contusions, and lacerations both knees medially just below knee joint. Abrasion-contusion and laceration right posterior upper calf.

[1] Mean value of tensiometer peak readings for each belt.
[2] Based on the examination and evaluations of Wendell Severy, M. D., Beverly Hills, Calif.
[3] No belt.
[4] The authors chose to delete these data because their accuracy could not be established. Structural buzzes confounded the basic data.

Mr. SEVERY. Comparisons of body dynamics under the different conditions of restraint together with pertinent qualitative information are shown in figure 6.

(Fig. 6 referred to is as follows:)

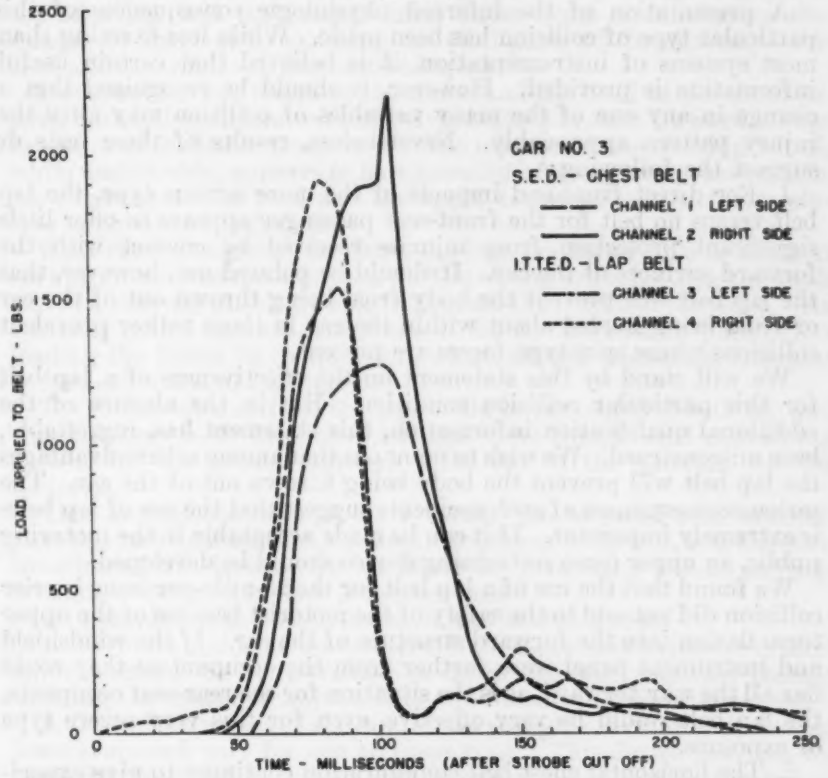
FIGURE 6



Mr. SEVERY. The magnitudes of belt loadings for one 29-mile-per-hour barrier collision are shown in figure 7.

(Fig. 7 referred to is as follows:)

FIGURE 7



Mr. SEVERY. It is recognized that a medical authority cannot be expected to translate, without qualification, structural damage occurring to an authropometric dummy into injuries which the human counterpart would have been subjected. It is also impractical for an engineer to attempt to evaluate precisely the structural failures and other more subtle indications of abuse to which an anthropometric dummy is subjected during collision in terms of human injury data. Until more basic data are procured concerning the average strength and resistance to injury of the various components of the human body, the combined judgment of the medical and engineering researcher appears to be the most practical approach to applying this type of instrumentation to the experimentally crashed car. These combined evaluations or interpretations of the physical consequences of dummy damage in terms of physiologic consequences of the inferred body injury are presented in table 2.

97108—57——12

On the basis of the observations presented in table 2, some conclusions are indicated. The reader is cautioned against regarding these findings as generalized or even specifically final in nature.

A presentation of the inferred physiologic consequences of this particular type of collision has been made. While less exacting than most systems of instrumentation, it is believed that certain useful information is provided. However, it should be recognized that a change in any one of the many variables of collision may alter the injury pattern appreciably. Nevertheless, results of these tests do suggest the following:

1. For direct front-end impacts of the more serious type, the lap belt versus no belt for the front-seat passenger appears to offer little significant protection from injuries received by contact with the forward surfaces of the car. It should be pointed out, however, that the lap belt will prevent the body from being thrown out of the car or from being hurled about within the car in those rather prevalent collisions where spin-type forces are present.

We will stand by this statement on the effectiveness of a lap belt for this particular collision condition. But in the absence of the additional qualification information, this statement has, regrettably, been misconstrued. We wish to point out that among other advantages the lap belt will prevent the body being htrown out of the car. The serious consequences of such accidents suggest that the use of lap belts is extremely important. If it can be made acceptable to the motoring public, an upper torso restraining device should be developed.

We found that the use of a lap belt for the 25-mile-per-hour barrier collision did not add to the safety of the motorist because of the upper torso flexion into the forward structure of the car. If the windshield and instrument panel were farther from the occupant so they could flex all the way forward, as is the situation for the rear-seat occupants, the lap belt would be very effective, even for this very severe type of exposure.

2. The horizontal chest belt configuration continues to give experimental results which indicate satisfactory protection from serious impact injuries. This belt does permit the hips and the legs to shift forward in the seat so that the knees strike the instrument panel. However, this action is considered to be less serious than the action of the lap belt which allows the head and the chest to strike the forward surfaces of the car's interior. So we see here a belt across the chest and under the arms which restrains the upper torso and head from impact with the forward sections of the car.

Before the use of this belt can be recommended, it is essential that the physiologic consequences, if any, of the pressures applied to the chest be investigated. This can be accomplished by conducting tests on live ape subjects. The use of cadavers is not recommended because some of the potential injuries of concern involve trauma observable only in live animals.

3. The shoulder-loop belt has proved to be the most promising single-unit restraining device evaluated to date. I am referring to the shoulder-loop belt which is a double-harness arrangement that goes around the shoulders and under the arms to a single point of fastening behind the shoulders.

This experimental unit was developed by ITTE for the purpose of motorist protection by the use of a single-unit restraining device.

Certain anatomic components of the human body are essential to life while others are convenient accessories to the function of living. Protecting the limbs, or at least the legs, from impact injuries by the use of a lap belt may compromise under some circumstances the chances of survival by exposing the vital parts of the anatomy—the head and the trunk—to destructive impact.

The shoulder belt restrains the trunk and the head at the shoulder level, permitting abdominal and pelvic regions to shift forward. This exposure of the lower trunk to possible injuries by the steering wheel, while undesirable, appears to be a more satisfactory compromise than the exposure of the head and the upper trunk because of their relative importance to survival.

With the feet against the floor, the legs are better able to restrain forward motion of the hips than the less strong arms, holding the weak rim of a steering wheel, are able to restrain the head and the chest. As the body shifts forward, the knees strike the instrument panel, thus loading the femur in compression, which affords additional restraint to forward travel of the hips.

The undesirable shift of the hips could be prevented if both lap and shoulder-loop belts were used, but this more complicated restraining system for the present appears to be out of the question for the motorist.

That is depicted in slide 5. I would like to point out, however, that this last combination, the shoulder loop and lap belt, was the combination of the devices that we chose for protecting human subjects running at 25 miles an hour into other cars.

As a conclusion to these remarks, it may be stated that:

1. In severe accidents the motorist is almost certain to receive critical injuries unless he is restrained to decelerate with the car, thereby shifting the abuses of impact from the human to the car structure.

2. The effectiveness of the lap belt as a single restraining device has been evaluated only for one accident type. This device prevents the motorist from being hurled destructively about within the car or ejected from the car. The driver remains behind the wheel where, by retaining or regaining control, he may prevent the occurrence of secondary impacts that actually may prove to be more injury producing than the initial collision.

These experimental studies point out that users of the lap-type belt should be cautioned against regarding this device as providing protection against injuries for all types of impacts. The observations of researchers at ITTE suggest that the lap belt will prevent fatal injuries from occurring for some types of impacts.

3. The experimental performance of the horizontal chest belt has been very good. It is nearly as simple to operate and provide a more positive restraint than the lap belt. It may not be as comfortable to wear, particularly for women motorists, and the physiologic consequences of its force system as a result of collision still must be evaluated before its use can be recommended.

4. Without the need for introducing a more complicated restraining system, the shoulder-loop belt shows promise of overcoming both possible injury-producing consequences of the chest belt and the need for upper torso restraint not provided by the lap-type belt. Nevertheless, this belt is still regarded as an experimental model, even though

with the use of dummies it has been tested in 3 collisions with impact velocities ranging up to 50 miles per hour, and with the use of human subjects, in 8 collisions to 25 miles per hour.

The lap belt applied a 3,500-pound restraining load to the dummy in the 25-mile-per-hour barrier collision and, while small compared with the load for a 50-mile-an-hour head-on collision, it is, nevertheless, a severe loading. For the 50-mile-an-hour head-on collision, we recorded a lap-belt loading in excess of 10,000 pounds.

HEAD MOVEMENT DURING IMPACT

Analysis of high-speed motion picture film revealed that the head of both the human and the dummy passed through a 1.5 cycle oscillation. For both the human and the dummy restrained at the upper torso, the head appeared to be forced as far forward as the neck would flex during the first phase of the impact.

After the car had decelerated nearly to zero velocity, the restitutional forces of the neck exceeded the now small deceleration forces of the head, applied through the neck, and the head was thrown back into an acute dorsiflexion position. Next with the velocity of the car now at zero, the restitutional forces which had developed in the collapsed portion of the car accelerated it from the barrier in the reversed direction.

This acceleration from zero velocity to 5 feet per second in combination with the forces of elasticity of the neck, in the case of the 25 mile per hour collision, forced the head all the way forward again, though less abruptly than in the case of the initial forward movement.

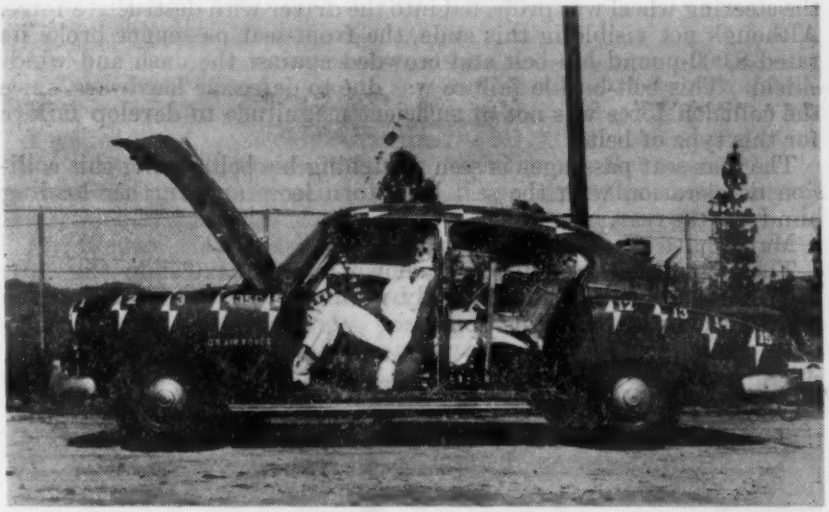
The resilient properties of the neck brought about the return of the head to an approximately erect position. Thus, the possibilities of "whiplash" injuries of the neck appeared to exist for the motorist who is restrained against a more violent trauma.

While making the car considerably safer for rear-end collision exposure, this problem could be alleviated simultaneously if the seat back were extended to provide head support in the vicinity of the seat where the head needs support against acute dorsiflexion.

Next slide, please.

In one of our experiments conducted this year for the Air Force, we equipped the dummies in the driver, the passengers in the right front and right rear seat positions with 4,000-pound lap belts with a loop strength of 8,000 pounds. Additionally, the driver was equipped with a shoulder loop belt secured to an inertia reel. This shoulder-belt configuration permits normal freedom only of the upper torso movement, but due to the action of the inertia reel forward motion is restrained during collision (fig. 8).

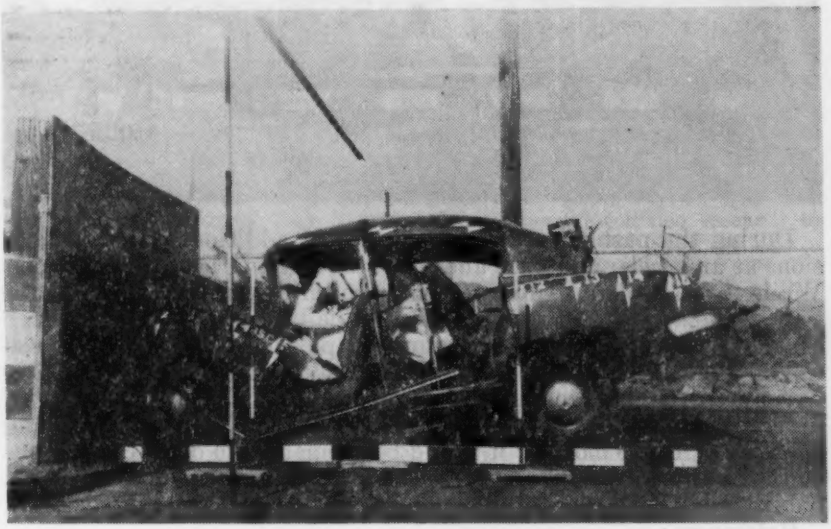
FIGURE 8



May I have the next slide.

Twenty-five miles an hour into a fixed barrier provides an adequately severe collision to evaluate the performance of these restraining devices. Observe that the driver's hips and shoulders have retained approximately the preimpact position despite the high decelerative forces (fig. 9).

FIGURE 9



The upper torso restraining device is the shoulder loop belt and the initial reel. In normal motion you can lean completely forward, but during collision deceleration the reel snubs this motion, preventing forward motion. It is a very effective device.

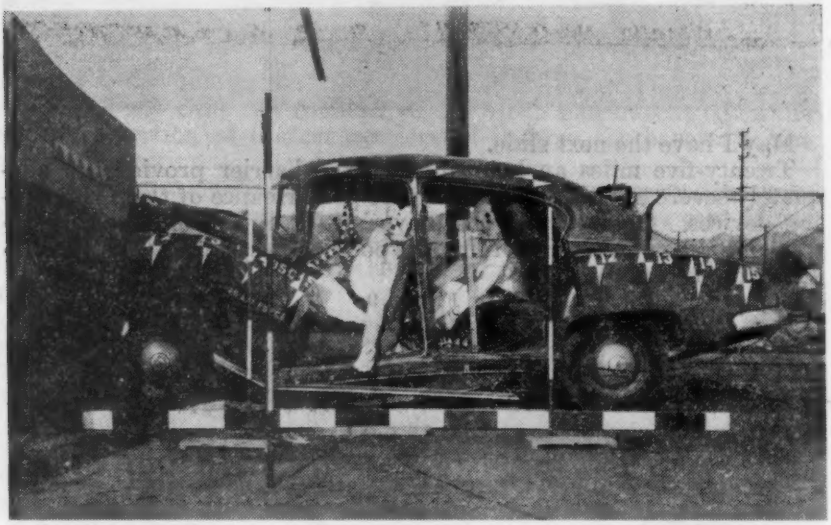
However, although the driver was prevented from shifting forward, the steering wheel was projected into the driver with destructive force. Although not visible in this slide, the front-seat passenger broke its rated 8,000-pound lap belt and crowded against the dash and windshield. This belt-buckle failure was due to defective hardware, since the collision force was not of sufficient magnitude to develop failure for this type of belt.

The rear-seat passenger is seen stretching his belt during this collision deceleration with the seat back torn loose and further loading him from the rear.

May I have the next slide?

The postcollision condition is shown in this next slide (fig. 10). The occupants are in a reasonably normal posture, except that the rear-seat back is out of position.

FIGURE 10



During the past year we have conducted additional barrier collisions at an accelerated pace and also rear-end and head-on collisions. While we had planned to do such research eventually, much of the past year's accelerated program was made possible through research contracts with the American Motors Corp., the Parish Pressed Steel Corp., a manufacturer of automobile frames, and the United States Air Force. This accelerated program resulted in the collection of a very considerable amount of data, which at this time are being analyzed. At the moment it would be premature to draw conclusions on the basis of these data, but from time to time in the future we shall publish additional reports on our findings.

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2. Human Exposures to Linear Deceleration, J. P. Stapp, United States Air Force, Wright-Patterson Air Force Base, Dayton, Ohio (December 1951).

3. Engineering Analysis of an Instrumented Head-On Collision, unpublished paper by J. H. Mathewson and D. M. Severy, October 1952.
4. Controlled Automobile Rear-End Collisions—An Investigation of Related Engineering and Medical Phenomena, D. M. Severy, J. H. Mathewson, and C. O. Bechtol (series 1, Montreal Conference on Medical Aspects of Traffic Accidents, McGill University, Montreal, Canada, May 4, 1955), Canadian Services Medical Journal II: 727–759 (1955).

I would like to take this opportunity, Mr. Chairman, if I may, to show a film, Head-On Collision at 50 Miles an Hour, in order to present the restraining action of a safety belt under these extreme impact conditions.

Mr. ROBERTS. May I ask how long will it take?

Mr. SEVERY. The film is 8 minutes.

Mr. ROBERTS. How much time do you require, Mr. Moore?

Mr. MOORE. I would require possibly 30 minutes or a little longer.

Mr. ROBERTS. In order to carry out this program, I would appreciate it very much if you could conclude your testimony at this point. I am sorry that the House is meeting at 11 o'clock this morning, but I have no control over that, as you understand. There may be some questions.

Mr. ROGERS. I have no questions.

Mr. SCHENCK. I have no questions.

Mr. ROBERTS. Thank you very much, Mr. Severy. We appreciate your appearing here. And you certainly have done an outstanding job, and the subcommittee is very grateful to you for appearing before us this morning.

I might say this, that if the hearings are not concluded this morning, and if we obtain permission to sit this afternoon, we would be glad to see the film then.

Mr. SEVERY. Thank you very much.

(The following attachment was submitted by Mr. Severy:)

IMPACT! * * * A NEW FILM FOR DRIVER EDUCATION

The University of California at Los Angeles is pleased to announce the forthcoming publication and release of the new 16-millimeter, 12-minute, black-and-white motion picture, Impact.

Science has broadened its horizons to include the study of the phenomena of impact associated with automobile collisions. The University of California summarizes its progress after 7 years of experimental collision research by reviewing the preparation, conduct, and results of collisions Nos. 30 and 31.

Two new automobiles, one of unitized, the other of conventional frame construction, are specially instrumented to record engineering and medical data during impact. High speed cameras record in superslow motion the spectacular crushing and extreme collapsing of these car structures from several angles both from within and outside the cars. Lifelike anthropometric dummy occupants of these vehicles are shown being crushed against the cars' interiors.

One subject's head is seen crashing through the windshield. Stop action high speed photography provides a clear insight into the injury-producing agencies associated with collision.

Engineering and medical postcollision analysis are described together with some of the more general findings resulting from these experiments. Seat belts are discussed as one form of car occupant protection.

Facts about the film: 16 millimeter, 12 minutes, black and white, sound, sales price, $55; rental, $2.50. For further information please write to: Educational Film Sales Department, University Extension, University of California, Los Angeles 24, Calif.

Mr. ROBERTS. Our next witness is John O. Moore, director of the automotive crash injury research project at Cornell Medical School, Cornell University.

Mr. Moore, I would like to say that the committee is glad to have you appear before us, and I think that the first visit that the subcommittee made was to the project at Cornell, and we have, of course, heard from you on other occasions. I think we are very fortunate to have the direction that you have given to this work at Cornell; I think the whole country is fortunate.

We are glad to have you before the subcommittee.

STATEMENT OF JOHN O. MOORE, DIRECTOR, AUTOMOBILE CRASH INJURY RESEARCH, CORNELL MEDICAL SCHOOL, CORNELL UNIVERSITY

Mr. MOORE. My name is John O. Moore; I am director of the automotive crash injury program at Cornell Medical School. It is located in the public health and preventive medicine department.

Chairman Roberts and members of the Subcommittee on Traffic Safety, it is our privilege to again be invited to present evidence which we have accumulated from the research program at Cornell University Medical College on aspects of injury observed in automobile accidents.

On the 30th of April of this year we submitted to your group the accumulated evidence which we had of the role which restraining devices play in reducing both the frequency and severity of injury when accidents occur. The material used in this recent testimony was gathered from sample areas on the highways of the States of North Carolina, Virginia, Maryland, Connecticut, Indiana, Pennsylvania, Vermont, Minnesota, Arizona, Texas, and California. We feel that we were able to offer an acceptably representative and reliable sample of the automobile accidents and injuries throughout our Nation.

At that time we made the statement that our findings were preliminary in nature, but that we felt them to be scientifically accurate.

We repeat the statement now, and add that the preliminary findings are confirmed clinically every day by an influx of information gathered by State police, State medical societies, and State departments of public health, building up into a still larger volume of data.

As of this date we have on file reports on more than 10,000 injury-producing and property-damage accidents involving nearly 24,000 persons. Also available are reports on nearly 700 accidents involving seat belts. These seat-belt accidents have been collected through a 22-State cooperative program, using the specially developed report form shown in slides 1 and 2.

(Slide 1, p. 1, of seat-belt form.)

SLIDE 1

A STUDY OF THE EFFECTIVENESS OF SEAT BELTS IN AUTO ACCIDENTS

AUTO CRASH INJURY RESEARCH

INDIANA STATE POLICE DEPARTMENT

STOUT FIELD,

INDIANAPOLIS 21, INDIANA

Upon completion MAIL TO:

(COUNTY)

Accident Date _____ Time: _____ Location _____

SEAT BELT TYPE:

Lap ☐ Combination lap and shoulder harness ☐

Width of webbing _____ inches

TRADE NAME OR MANUFACTURER OF:

Belt: _____

Buckle (If not the same) _____

SPECIFICATIONS of belt installation. Check where applicable.

Terminals attached to:	How attached:
☐ Floor pan	☐ Vertical bolt _____ in. thick
☐ Frame	☐ U-bolt _____ in. thick
☐ Door	☐ _____ inch cable and wire clamps
☐ Seat	☐ (other) _____

Sketch installation and indicate how unit is anchored. Give measurements of anchor plates, washers, transverse bars, etc., if used.

SEATED POSITION	PHYSICAL FACTORS				BELTS PROVIDED		BELT SECURED DURING COLLISION		INJURED	NOT INJURED	COMPLETELY EJECTED	NOT EJECTED	DEGREE OF BELT ADJUSTMENT TIGHT, SNUG (AVERAGE), LOOSE
	AGE	WGT	HGT	SEX	YES	NO	YES	NO					
DRIVER													
CENTER FRONT													
RIGHT FRONT													
LEFT REAR													
CENTER REAR													
RIGHT REAR													

SEAT BELT PERFORMANCE: (If webbing, buckle, attachment fittings, etc., failed in any way, please give specific information, i.e. location and extent of webbing failure, defective buckle component, etc.)

DESCRIPTION AND SKETCH OF ACCIDENT (Sketch position of car(s) before, at, and after impact. Show object struck. Show rollover. If occupants were ejected from car show when and where. Indicate direction of principal impact on vehicle. If photographs taken please attach.

Remarks: _____

(Slide 2, p. 2, of seat-belt form.)

SLIDE 2

COLLISION

SUBJECT CAR → { STRUCK ☐ / WAS STRUCK BY ☐ } → { MOVING ☐ / STATIONARY ☐ } → { VEHICLE ☐ / OBJECT ☐ }

If car struck object, describe: (stone abutment; tree (6 in. diam.); fence (log). If object was moved by impact, state extent.

ROLLOVER NO ☐

☐ ROLLOVER BEFORE COLLISION

☐ ROLLOVER AFTER COLLISION

☐ ROLLOVER WITHOUT COLLISION

___ AMOUNT (¼, ½, ¾, 1, 2, UNK., ETC.)

ESTIMATED SPEEDS

	PRIOR TO ACCIDENT	AT IMPACT
SUBJECT CAR		
PRINCIPAL OTHER VEHICLE		

VEHICLES

MAKE OF CAR	YEAR	BODY STYLE (2 DOOR SEDAN, 4 DOOR SEDAN, ETC.)

DOORS OPENED

	FORCED OPEN IN ACCIDENT		DOOR SAFETY LATCH ENGAGED	
	YES	NO	YES	NO
LT. FRONT	☐	☐	☐	☐
RT. FRONT	☐	☐	☐	☐
LT. REAR	☐	☐	☐	☐
RT. REAR	☐	☐	☐	☐

DRIVER

NAME

ADDRESS

HOSPITAL OR PHYSICIAN*

NAME

ADDRESS

INJURIES AND THEIR CAUSES. For each occupant, briefly describe injuries; use arrows to show their location and indicate objects causing them (See Sample)

DRIVER

CENTER FRONT SEAT

RIGHT FRONT SEAT

LEFT REAR SEAT

CENTER REAR SEAT

RIGHT REAR SEAT

*If available, please attach medical report by attending physician

Mr. MOORE. 412 of these seat-belt accident cases, already analyzed and coded on IBM cards, furnished some of the evidence presented in the statements which follow.

Today we offer first as evidence the two charts which we have previously shown on the effectiveness of seat belts in protecting against injury when an accident occurs.

Slide 3 (an evaluation of safety-belt effectiveness in automobile accidents, as demonstrated by a clinical study of 236 occupants of 162 cars in rural accidents).

SLIDE 3

An Evaluation of Safety Belt Effectiveness in Automobile Accidents

(As demonstrated by a clinical study of 236 occupants of 162 cars in rural accidents)

I. **CONTROL GROUP** (without safety belts): 81 cars, 139 occupants

EXPERIMENTAL GROUP (with safety belts): 81 cars, 97 occupants

II. Control and Experimental Groups identical as to:

1. Type of Accident
2. Area of Principal Impact
3. Direction of Principal Force
4. Speed at Impact
5. Frequency of Doors Opening
6. Number of Cars per Accident
7. Make of Case Car
8. Weight of Case Car
9. Year of Manufature of Case Car
10. Seated Area of Occupants

III. RESULTS OF COMPARISON

Type of Injury	Frequency of Injury Among Control Group	Frequency of Injury Among Experimental Group	Results in Statistical Analysis	MAXIMUM IMPROVEMENT DEMONSTRATED
All degrees	75.5%	29.9%	Difference significant at 99.9% level of confidence	60.4%
Moderate-fatal grade injury	23.0%	9.2%	Difference significant at 98.0% level of confidence	60.0%
Dangerous-fatal grade injury	3.6%	1.0%	Difference not statistically significant	None (probably due to small sample-size)

Mr. MOORE. In slide No. 3 we have used the "paired comparison technique" to examine 81 pairs of accidents, each pair being identical on 10 points of accident similarity, as shown. The 97 occupants of 81 of these cars each had a belt over which they could flex; in the other 81 cars, the 139 occupants had no belts to flex over, and some of these were ejected. We believe that the 60-percent reduction in the risk of injury observed among the seat-belt users represents a satisfactory answer to the criticism that additional injury will be produced when belts are used.

Slide 4: An evaluation of safety-belt effectiveness in automobile accidents, as demonstrated by a clinical study of 92 occupants of 72 cars in rural accidents.

(The document referred to is as follows:)

SLIDE 4

AN EVALUATION OF SAFETY BELT EFFECTIVENESS IN AUTOMOBILE ACCIDENTS

(As demonstrated by a clinical study of 92 occupants of 72 cars in rural accidents)

1.

Control Group	Experimental Group
Ejectees in accidents (without safety belts)	Non-ejectees in accidents (wearing safety belts)
36 cars, 46 occupants	36 cars, 46 occupants

11. Control and Experimental Groups identical as to:

1. Type of Accident
2. Direction of Principal Force
3. Area of Principal Impact
4. Speed at Impact
5. Number of Cars per Accident
6. Seated Area of Occupants
7. Accident Severity
8. Body Style

111. Results of Comparison

Type of Injury	Frequency of Injury: Control Group	Frequency of Injury: Experimental Group	Results in Statistical Analysis	Maximum Improvement Demonstrated
All degrees	87.0	39.3	Difference significant at 99.9% level of confidence	54.8%
Moderate-fatal grade injury	53.7	10.9	Difference significant at 99.5% level of confidence	79.7%
Dangerous-fat. grade injury	17.4	2.2	Difference significant at 95% level of confidence	87.4%

Mr. MOORE. In slide No. 3 we compared injury results seen among a group of belt-retained car occupants to those seen among a group of car occupants without belts, some of whom were ejected and others not.

In slide No. 4, shown here, we again used the "paired comparison technique" to examine the injuries sustained among ejected persons as opposed to those sustained by nonejected persons flexing over seat belts.

Here, in 36 identical pairs of accidents, were 46 occupants who were ejected because they had no belts and 46 occupants who remained inside cars because they had belts. In each pair of 36 accident cases, one or both front doors of the automobiles opened under crash-impact conditions and presented the hazard of ejection. You will observe the difference in risks of injury to the effect that the amount of reduction in the injury risk increases as the grade or severity of injury goes up. Even more important, it can be seen that the greatest area of improvement is offered by the seat belt in its role of preventing ejection, rather than reducing the severity of injuries inside the car.

By quick examination you can see that we get in this slide the weight and size of the human being, the seating position, factors regarding the make and model of the car, its reported speeds, and the description of the injury on the mannikin.

At this point we would like to introduce evidence which gives a further perspective view of seat belts in influencing injury patterns. This view deals with the general observation that, as automobile accident severity (damage and force conditions) increases, there is a corresponding increase in the seriousness of injury sustained.

Slide 5: Comparison of injuries sustained under similar accidental conditions with and without use of seat belts.

(The document referred to is as follows:)

SLIDE 5

Comparison of injuries sustained under similar accident conditions with and without use of seat belts [1]

Accident severity	Injury sustained by seat-belt user	Average injury (range) sustained by nonusers of seat belts
Minor	None	None to minor.
Moderate	do	Minor to moderate.
Moderately severe	Minor	Moderate to serious.
Severe	Moderate	Serious to critical.
Extremely severe	Severe	Critical to fatal.

[1] In each accident-severity class, a seat-belt case was matched with a randomly selected group of 10 cases experiencing the same impact speed, area of impact, direction of impact force, type of collision, and body style of car.

Mr. MOORE. The comparative data shown on this slide were selected not only on the basis of identical accident severity, but also on other accident factors such as body style of car, area of impact, direction of force, number and type of vehicles involved, and impact speed. For each randomly selected seat-belt case of a given severity, there was made a random selection of 10 cases of cars without seat belts, but experiencing the same accident severity and identical accident features as described above.

The slide shows injury data observed in the seat-belt cases, and by using a point system of rating injuries, establishes the range of injury seen in the 10 matching cases without seat belts. The data shows that, whether or not a seat belt was worn, as the accidents became more severe in terms of damage and force conditions, the injury or injury range became more severe. However, in each accident-severity class, accident victims without belts were injured more seriously.

They were identical as to type, speed, and so forth, area of the car height.

It is our opinion that due regard should be given to all evidence which can be submitted regarding the effectiveness or lack of effectiveness of restraining devices as a means of controlling death and injury in automobile accidents. However, it should be recognized that negative aspects of seat belts should be accepted as part of the overall safety picture. Granting that seat belts under some unique conditions can be cited "dangerous" as the direct or indirect cause of death or injury, it must be remembered that safety—like law or medicine—works for the majority.

While some unfortunate few suffer on occasion, vast numbers benefit. Without system there is chaos and anarchy, whether it is in the area of justice, health, or safety.

The rules and procedures in each of these areas are established by observation of occurrences which are common, rather than exceptional. We do not bypass or ignore the use of a drug or vaccine which may in rare circumstances cause death. We do not reject laws because they sometimes miscarry. We cannot cast aside seat belts because they can be demonstrated to cause harm in some few cases.

Evidence about the actual performance of seat belts should be weighed, in our opinion, in the light of the entire accident picture. This automotive crash injury research presentation evaluates some of the current criticism of seat belts on the basis of facts observed in our national sample of over 10,000 accidents.

This was covered by Colonel Stapp as well as Mr. Haynes of the Ford Motor Co., and it is available in the record of the committee.

Current adverse criticisms of seat belts seem to emanate from two basic source types. The first is the laboratory source type.

Although most of the laboratory, or crash experiments furnishing data are scientifically conceived and accurately executed, the conclusions reached from this type of test or experiment relate to observation of the kinematic behavior of anthropomorphic dummies.

Such material must be considered carefully to determine whether it can be accurately or even reasonably applied to humans in actual automobile accidents. Further, these tests are segmental or isolated in perspective in that they deal with a particular type of accident. All too often the results observed in the experiments are interpreted as applying to the entire automobile accident population, when in reality they sometimes may represent unique or relatively infrequent circumstances.

The second source type of criticism of seat belts consists of opinions. These are conceived mostly by fanatics and dogooders, often on a basis of inadequate or entirely unreliable information.

Usually, emotional interpretation of laboratory crash tests or of newspaper reports of accidents characterize these criticisms.

Of course, we do not mean to imply that newspaper reports of accidents are of a questionable nature. We merely mean to suggest that the newspaper reporter is not a trained accident investigator. Much confusion is caused by unqualified interpretation of whatever facts have been observed by newsmen.

While it has never been the function of our group, as scientific investigators, to take issue with critics under any but the most unusual circumstances, we feel that the criticisms of the two types just mentioned have produced so much confusion in the minds of the public that we must amplify our normal procedure of factual presentation by examining, for the remainder of our testimony, some of these criticisms.

Here is an example of the opinion source type of information on seat belts. An article from the August 1957 issue of a leading consumer magazine is quoted. Close examination of the article text permits fair evaluation of its credibility.

Slide 6: First section of seat-belt article in a consumer magazine.

(The article referred to is as follows:)

SLIDES 6, 7, 8, AND 9

A CONSUMERS MAGAZINE ARTICLE ON SAFETY BELTS

The article on this subject in the March issue created considerable interest among our readers, and we received many letters from persons who took a strong position in favor of universal use of safety belts. Most of the writers admitted that safety belts had their limitations, but claimed that they should be used nevertheless. None, however, submitted proof that belts for the front seats would prevent injuries to the head, which are a most common and most dangerous type of injury.

A number of cases have come to CR's notice in which a safety belt contributed to injury or death, or caused an accident, or in which the absence of a safety belt would have given the person involved at least a chance for life or would have prevented serious injury.

The most recent of these cases was the airplane accident in which the President of the Philippines, Ramon Magsaysay, was killed. One of the men of 26 in the party survived; his life was saved because he had disobeyed the injunction given to everyone before the accident to buckle on this safety belt. Choosing not to follow the order, he was able to crawl from the wreckage and lived through an accident which killed 25 others.

If you plan to buy safety belts for your car, it would, in our view, be best to have them installed for the passengers in the rear seats. There the belts can be of value in preventing the rear-seat passengers from being thrown forward projectilewise into the heads and bodies of the front-seat passengers; restraining the rear-seat passengers will reduce greatly the impact forces to which the passengers in the front seat will be subjected in the event a head-on crash or collision occurs.

Mr. MOORE. Notice the illogicality of reasoning. Whether or not readers sent letters to the magazine is irrelevant to the question of head injuries. Further, why should it be assumed that seat belts must prevent all head injuries? They actually can occur whether or not a belt is used.

In addition, there is ample evidence from scientific research sources that the belt can actually reduce the force of head blows and thus reduce the frequency and severity of head injury.

A number of cases have come to CR's notice in which a safety belt contributed to injury or death or caused an accident, or in which the absence of a safety belt would have given the person involved at least a chance for life, or would have prevented serious injury.

In any event, the major purpose of the belt is to prevent ejection and to minimize injuries inside the car—not to totally prevent injury to any one body area.

Slide 7: Second section of seat-belt article in a consumer magazine.

The implication made here is unwarranted. Whether the cases referred to are newspaper reports or eyewitness accounts, they happen to be only the ones received. Undoubtedly it is far more likely that a newspaper will print an account of an accident where a belt seemed to have caused death or injury than an account of an accident in which it may have prevented death or injury. No injury is no news.

Thus, news reports cannot be used to determine the true frequency or infrequency of an occurrence. The statement that in the cases observed the belt was a responsible agent is purely an opinion based on the investigation or reporting of others and does not constitute proof of any sort. It is exceedingly doubtful whether the writers or editors of this magazine examined the accident themselves.

I mean to be conservative when I say it is extremely doubtful.

Slide 8: Third section of seat-belt article in a consumer magazine.

The statement made here is known to have been based chiefly on newspaper accounts of the accident, carried in a well-known New York newspaper.

It is pure assumption on the part of the writer that the 25 persons killed would have lived if they had not worn their belts. Trained investigators of aircraft accidents queried on this matter commented that in most likelihood the deaths were due to violent impact conditions and had no connection with the seat belts. In any event, they were unwilling to form any firm opinion as to the cause of death in this accident without having observed the precise accident details.

Slide 9: Fourth section of seat-belt article in a consumer magazine:

If you plan to buy safety belts for your car, it would be, in our view, the best to have them installed for the passenger in the rear seats. There the belts can be of value in preventing the rear-seat passengers from being thrown forward, projectile-wise, into the heads and bodies of the front-seat passengers. Restraining the rear-seat passengers will reduce greatly the impact forces to which the passengers in the front seat will be subjected, in the event a head-on crash or collision occurs.

The advice given here is not grounded in reason. Actual analysis of thousands of automobile accidents has shown that the influence of rear-seat passengers on the occurrence of injury to front-seat occupants is, at most, minimal. No regard is given in this section of the article to the use of a belt in minimizing injuries among the rear-seat passengers themselves. Further, no consideration of the belt's ability to prevent ejection—of front or rear passengers—is made; nor is it for a moment realized that the use of belts by front-seat passengers—even if they were struck by rear occupants—might prevent or minimize contact with forward structures.

This article is basically irresponsible and appears to have no scientific or even remotely logical basis for the conclusions it draws. The opinions it offers and the real or implied recommendations it makes are unfortunately representative of many opinion articles of unqualified observers who presume to advise the public on safety matters.

Now we come to some specific criticisms of seat belts. One of these is to the effect that seat belts are the direct cause of internal injuries to wearers in accidents. Recently, Dr. Jacob Kulowski of St. Joseph, Mo., accurately documented a case of internal injury associated with seat belt usage.

Although Dr. Kulowski was careful to point out that the case may have been a unique one, his published report has been parlayed by others into direct criticism of seat belts. That was mentioned to this committee.

With respect to belts and internal injuries, a study of 1,000 survivors of light airplane crashes performed by aviation crash injury research of Cornell showed that .09 percent of those survivors who used belts had dangerous lower torso injuries which could reasonably have been attributed to seat belt usage.

We are quite sure that in this particular area, the data maintained by the Medical Division of the Directorate of Flight Safety Research of the United States Air Force would confirm the Cornell findings.

In the seat-belt accident cases analyzed by automotive crash injury research, 0.4 percent of the wearers had dangerous or even fatal injuries of the lower torso which could possibly be attributed to the belt.

On the other hand, among more than 15,000 nonusers of seat belts in injury producing accidents, 225, or 2.5 percent sustained dangerous or fatal lower torso injuries. The 0.4 percent frequency of such injury among belt wearers, compared to the 2.5 percent frequency seen among nonusers of belts clearly indicates the protective qualities of the seat belts with respect to lower torso injuries; the data also definitely suggests quite the reverse of the criticism that seat belts are dangerous in causing abdominal injuries, in that the incidence of this type of injury is actually quite low.

Another criticism is that seat belts in accidents prevent escape from cars in the event of fire or submersion. Evidence available at this time from over 10,000 reports of accidents shows that burning and submersion accidents are extremely rare. The percent of accidents, injury-producing or property damage, which involved fire or submersion in our sample are as follows: Fire, 0.19 percent (two-tenths of 1 percent); submersion, 0.26 percent (three-tenths of 1 percent). Belts in such accidents, while they may be thought to be responsible for death or injury, often have no connection with it.

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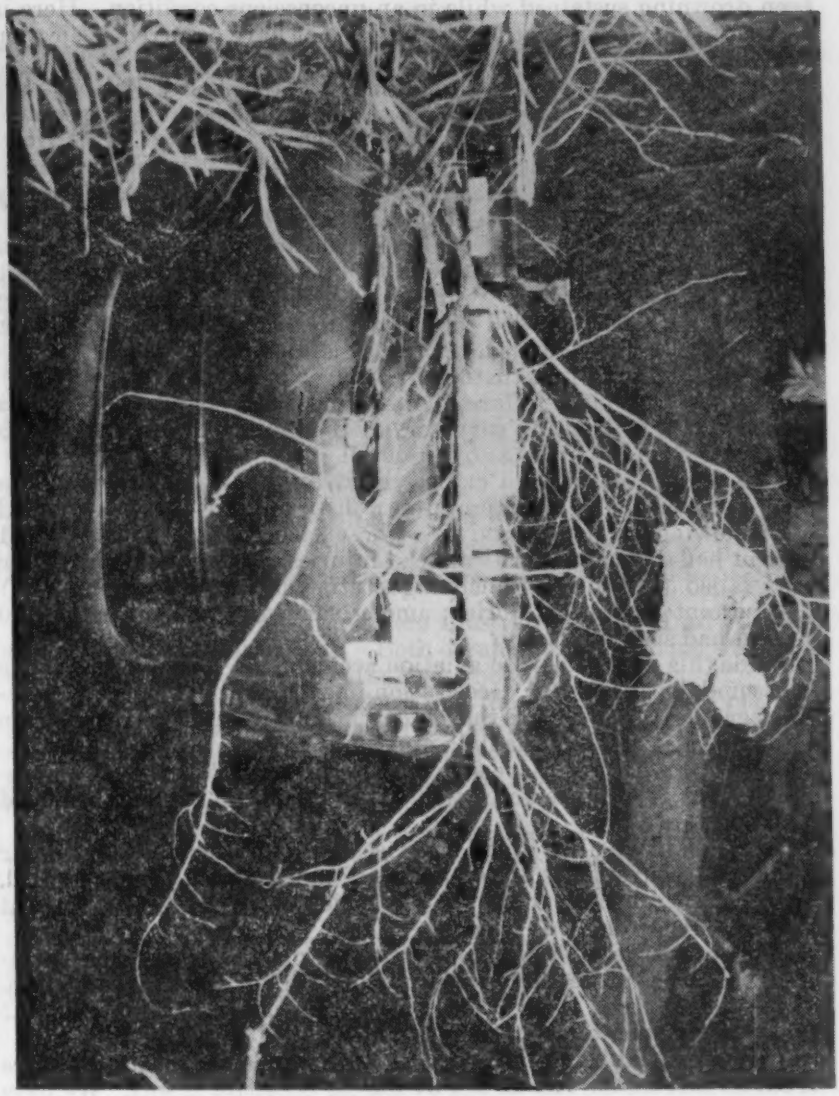
SLIDE 10

Mr. MOORE. In this crash, the driver was killed. It is not reasonable to assume that the belt in such a severe impact, or that any protective device in such a severe impact, would have had very much bearing on survival. In any event, the force and damage conditions would most likely have presented a corpse to be burned whether or not it wore a belt. The violent damage and force conditions seen in this case represent a large proportion of the burning cases on file, which are nineteen one-hundredths of 1 percent.

SLIDE 11



SLIDE 11

Mr. MOORE. Slide 11 shows the wreckage of a car, one of the occupants of which drowned. The water cannot be seen in the photograph, but is just ahead of the car. In this case, the occupant in question was ejected from the car and thrown, face down, into 8 inches of water. The reporting physician stated the cause of death to have been drowning sustained while in an unconscious condition. Here is a case of submersion death which might not have occurred if ejection had been prevented.

Another criticism which is often heard is that many seat belts are inadequately designed or installed. Numerous laboratory tests have established that some belts are indeed not as efficient as others. However, the knowledge that some belts fail should not preclude the use of well engineered ones. The maintenance of adequate standards by agreements methods or by legalization is readily obtainable.

A series of 412 reports of cars in accidents with seat belts showed that 9 out of 459 users of seat belts (1.9 percent) experienced failure of their protective device. While this 1.9 percent figure representing failure cannot be regarded as completely accurate until a greater volume of data is examined, the figure is reassuringly small. (Certainly the figure will fluctuate with changes in seat-belt designs.)

With respect to belt failure, there is evidence from analysis of data on more than a thousand survivors of light plane crashes that belts which failed are better than no belts at all.

Considering serious and critical head injuries, for example, data from the aviation crash injury research project of Cornell revealed the following: Among survivors whose belts remained intact, 10.1 percent had serious and critical head injuries; among survivors whose belts failed (breaking of anchorages, attachments, or webbing, etc.) 29.4 percent had such injuries; among survivors without belts, 41.0 percent had such injuries.

While this data relates to aviation accidents, it is not unreasonable to assume that impact or deceleration phenomena are relatively similar regardless of whether they occur in an airplane, a truck, or an automobile. Certainly the data appear to be corroborated by laboratory crash tests which have shown that the use of seat belts in automobiles can reduce the force with which the head contacts forward structures.

Here is still another criticism of seat belts; when rollovers occur in open-top convertibles, the occupants retained by seat belts are killed, whereas if thrown clear they could have survived. Let us look at some fact regarding this criticism.

The occurrence of death under the described circumstances is indeed possible, but requires some perspective for proper evaluation. First, among more than 6,000 injury-producing cases analyzed, 1.5 percent were open-top convertibles which rolled over.

Critics say that being thrown clear in an accident provides a chance of survival if the surface struck by the car occupant is soft. We have not been able to measure the difference in surface that many thousands of people have hit, but it is the observation of our 17 analysts that the vast majority of these occur either on hard road surface or rocky areas.

Actually, although automotive crash injury research has not measured the frequency, seven teams of automotive crash injury research

accident analysts have observed that the vast majority of ejections occur either on hard road surfaces or rocky areas associated with road shoulder designs. Further, it must be considered that sometimes ejected persons are killed by the car rolling over on them or by another car in the accident striking them.

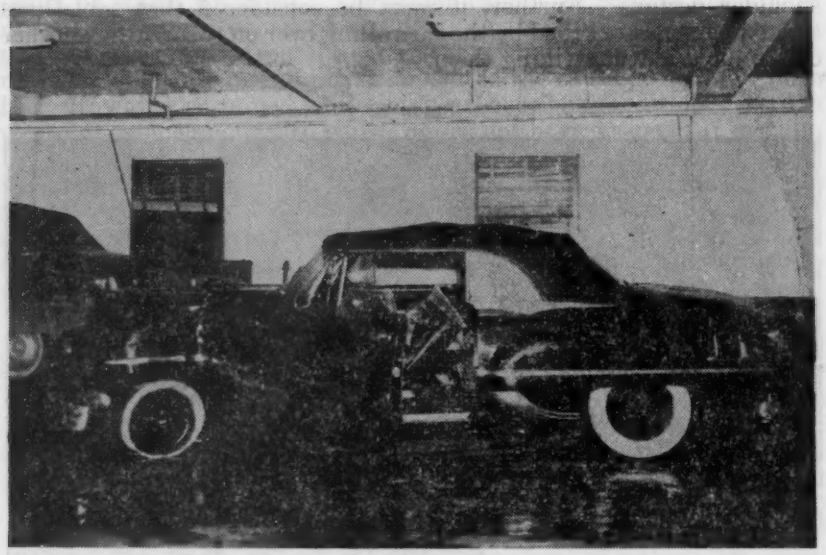
SLIDE 12

Mr. MOORE. The photograph here illustrates a case of an open-top convertible which rolled over. Both occupants, not wearing seat belts, were ejected onto the hard road surface and killed.

We would not dare to conjecture that these persons would not have been killed if they had worn their belts—which ironically, as can be seen in the photograph, were installed in the car. It would seem that a rollover in a soft-top convertible can be dangerous with or without belts.

Perspective of the problem here can be gained by consideration of the part of this accident-type plays in the overall accident picture. Soft-top convertibles, like other body styles, roll over in injury-producing accidents about 20 percent of the time. Since no one can choose the type of accident he will be in, it is not sensible to ignore the use of seat belts in soft-top convertibles because when they do roll over an unusually hazardous condition may exist.

SLIDE 13



Mr. ROBERTS. Can you tell me what percentage of automobiles manufactured are of the convertible type?

Mr. MOORE. I do not know the national registration figures, Mr. Chairman, but in our data they represent approximately 6 percent of our volume of cars.

Mr. ROBERTS. About 6 percent?

Mr. MOORE. Yes.

Mr. ROBERTS. All right, proceed.

Mr. MOORE. The photograph here is of a soft-top convertible which struck a tree. It did not roll over. The driver was ejected through a door which opened under crash impact.

He struck another tree with his head and was killed. Judging from the damage and impact speed (40 miles per hour), it is easily conceivable that the driver of this car might have lived if he had stayed inside the car. (Photographs of accidents which will be shown subsequently will demonstrate this possibility.)

In this case, as in approximately 80 percent of the injury-producing cases analyzed (cases which do not involve rollover) 38 percent of the cars had one or both front doors open from crash force. As a result, one quarter of the occupants in those cars were ejected. The injury risk posed by ejection in nonrollover cases far outweighs the risk incurred when open-top convertibles roll over. More people are involved in nonrollovers than in rollovers, and the use of belts is dictated by the vast number who would benefit.

Lest it be assumed that a rollover in a soft-top convertible is inevitably hazardous, we present another demonstration case.

SLIDE 14

Mr. MOORE. In the case shown here, the car rolled over two or more times, and ejection did not occur. Actually, no injury was sustained by the car occupant. Our group would not presume the opinion, on the basis of this one case, that rollovers in soft-top convertibles are not dangerous. As has been seen, all sorts of things can happen in these cars, with or without belts, with or without rollover. The final evaluation rests with the overall picture, not with unique cases.

Here is criticism of another sort. We quote from an article in the New York Times on the 28th of July 1957, written by Mr. Joseph C. Ingraham.

> Statistics, says Dr. White (Mr. Andrew J. White, of motor vehicle research), show how many people have been killed by being thrown from cars, but they do not show how many of these same motorists might still have been killed if they had not been thrown out.

Here are the facts we have regarding this criticism. Presumably, the statistics referred to by Mr. White are those of the automotive crash injury research project, since there is no other group, to our knowledge, which has prepared data on fatality rates according to ejection.

This rate is 12.8 percent for car occupants completely ejected through open doors in injury-producing accidents. Actually, the same basic statistics which provide the fatality rate for ejectees provide the fatality rate for nonejectees.

This rate is 2.6 percent, 5 times less. Thus, the risk of fatality is 5 to 1 for ejectees versus nonejectees. Further, these data can be used and interpreted by standard statistical calculations to determine how many ejectees who had been killed might still have been killed, as Mr. White asks, if they had not been thrown out (slide 15).

SLIDE 15

Observed and expected fatality frequencies among ejectees, with regard to accident severity and seating area occupied

Accident severity	Seating area occupied	Nonejectees		Ejectees		
		Total persons observed	Fatally injured persons observed	Total persons observed	Fatally injured persons observed	Fatally injured persons expected
Minor	Driver alone	62	0	10	1	0
	Driver with passenger	122	0	5	0	0
	Center front	34	0	1	0	0
	Right front	101	0	9	0	0
	Left rear	33	0	2	0	0
	Center rear	20	0	1	0	0
	Right rear	39	0	2	0	0
	Seat not reported	25	0	0	0	0
Moderate	Driver alone	265	2	32	3	.24
	Driver with passenger	609	1	42	2	0
	Center front	177	0	21	1	0
	Right front	491	2	65	2	.27
	Left rear	131	0	4	0	0
	Center rear	68	1	3	0	.04
	Right rear	150	0	9	0	0
	Seat not reported	134	1	7	0	.05
Moderately severe	Driver alone	329	6	70	6	1.27
	Driver with passenger	680	4	100	8	.59
	Center front	187	1	29	0	.15
	Right front	578	6	115	14	1.19
	Left rear	167	0	8	0	0
	Center rear	79	1	3	0	.04
	Right rear	166	1	11	3	.07
	Seat not reported	90	2	15	0	.33
Severe	Driver alone	126	16	62	12	7.87
	Driver with passenger	241	18	76	9	5.68
	Center front	76	3	22	2	.87
	Right front	215	25	80	16	9.30
	Left rear	62	1	8	0	.13
	Center rear	40	2	4	0	0
	Right rear	66	5	16	1	1.21
	Seat not reported	42	5	15	4	1.79
Extremely severe and extreme.	Driver alone	29	14	23	9	11.10
	Driver with passenger	44	9	24	9	4.91
	Center front	12	2	6	2	1.00
	Right front	37	14	18	6	2.27
	Left rear	7	1	10	6	1.43
	Center rear	9	1	4	2	.44
	Right rear	12	1	7	1	.58
	Seat not reported	16	2	4	2	.50
Total		5,771	147	943	121	53.32

Mr. MOORE. The table shown deals with the knowledge that, as the severity of the accident (damage and force conditions) grows greater, the likelihood of fatality correspondingly increases. The table also deals with the fact that different seating areas of the car have different fatality potentials. For each accident-severity class and seating area, the table shows the fatality rate observed among nonejected persons. It is reasonable to assume that if the persons ejected in each accident severity class and from each seated area had, instead, stayed inside the car, their fatality rates would have been the same as the nonejected persons in similar classification. With this assumption in mind, the table demonstrates the actual fatality rates observed for ejectees and the expected fatality rates if they had not been ejected.

It will be seen, generally, that in each accident severity had a strong bearing on the results. The more severe the accident in terms of damage and force conditions, the less chance of survival there was if an ejectee had been retained inside the car. However, even in the severer classes of accidents, the nonejectees fared better than those persons thrown out of the car.

The data in this table also enables us to estimate the saving in lives if persons ejected had been kept inside the car.

Among the nonejectees there were 147 fatalities. Based on expectancies, there should have been 53 fatalities among the ejectees even if they had stayed inside the car. This answers Mr. White's question.

Among 121 killed ejected persons 53, or 43.8 percent, would nevertheless have died even if they had remained inside the car. On the other hand, 56.2 percent would have lived.

Let us go one step further to look at the overall picture. Expected were 200 fatalities (147 plus 53) if ejection had been controlled. But in actuality there were 268 fatalities among both ejectees and nonejectees. Thus, the saving in lives can be calculated for the total population. We expect 200 lives would have been lost if ejection had not taken place.

The difference between 268 and 200—68—represents the saving; expressed in ratio—68/268—this is a saving of 25 percent. We might point out here that this methodology employed can be extrapolated to give us some idea of the actual number of lives which might be saved annually in our country if ejection were controlled by such means as seat belts or strengthened door locks.

Taking the approximately 40,000 persons who have been killed for the past few years in automobile accidents and generously assuming that many of these were pedestrians or occupants of vehicles other than automobiles and that we were left with, say, 20,000 persons to whom the ejection problem might be applicable—we could save 5,000 lives yearly through control of ejection. How many drugs or vaccines can promise to save so many lives annually?

Here is still another criticism: Seat belts in retaining passengers inside the car, expose them to new hazards. Again we present automotive crash injury research facts in evaluating the criticism.

The frequency with which major car components have been observed to associate with dangerous or fatal grades of injury among car occupants in injury-producing accidents is as follows:

Ejection, 3.2 percent. Steering assembly, 2.5 percent. Backrest of front seat (top portion), 1.1 percent. Instrument panel, 0.7 percent. Front corner post, 0.7 percent. Windshield, 0.6 percent.

Doors which open to permit ejection pose a greater risk of dangerous or fatal grades of injury than any other interior car component. The prevention of ejection, as the data show, will tend to associate car occupants with car components which have a lesser hazard.

Generally speaking, the effective seat belt can prevent contacts with front corner posts, windshields, and backrests of the front seat, as has been demonstrated by many laboratory crash tests.

The most important interior components remaining as hazards, then, are the steering assembly and the instrument panel. Both these components, as well as others, can have their injury potential controlled through corrective design engineering.

Crash injury research data have already demonstrated that padded instrument panels and recessed-hub steering wheels have a lesser injury potential than preceding designs seen in automobiles before 1956.

Much confusion has been brought about regarding the effectiveness of seat belts as a result of highly publicized experiments crashing cars into fixed objects. The opinions generated by these experiments

are that the belt is a lethal device and should not be used under any circumstances. The tests performed often simulated forward impacts of the entire fronts of cars against immovable objects such as steam rollers or barriers of varying description.

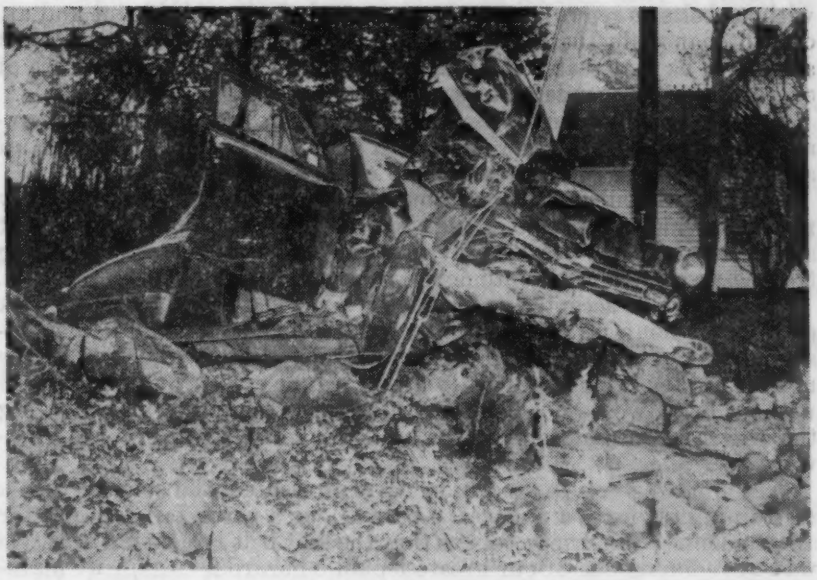
Automotive crash injury research data on injury-producing accidents revealed that on the actual highway all kinds of collisions with fixed objects represent about 16 percent of injury-producing accidents.

However, the specialized circumstances duplicated in experimental tests being discussed represent only 4 percent of injury-producing accidents. Typically, these experiments produced broken seat-belt installations and smashed dummies which led to conclusions proclaiming the lethality of seat belts.

In the accident shown here, the car collided with the tree at 45–50 miles per hour. The driver was not wearing a seat belt and was killed by striking the rear-view mirror and windshield header area. His death can certainly not be attributed, in this case, to the use of a belt, but it is conceivable that the belt might have prevented contact with the structures causing death.

SLIDE 16

SLIDE 17



In the accident shown here, the car collided with the stone wall at 45 miles per hour. The driver, without a belt, survived with minor injuries. These two cases serve to show that this type of crash may or may not cause death—without seat belts.

Why not assume that if seat belts had been used—as in the demonstration of rollover accidents of convertibles—the outcome in terms of survival could not be anticipated and actually might be subject to control through design engineering?

Finally, there is one more criticism of seat belts which we will attempt to evaluate: This criticism is to the effect that drivers using seat belts have a sense of false security, and may become overconfident. Automotive crash injury research data cannot tell whether the use of belts has any bearing on the occurrence of accidents themselves, but it can examine injury-producing accident data to see whether there is any false security indicated in terms of speed.

The average traveling speed observed in injury-producing accidents was as follows: In 412 cars with seat belts—47.7 miles per hour; in 6,177 cars without belts—49.2 miles per hour. The percentage of cars traveling above 50 miles per hour was as follows: In 412 cars with seat belts—51.7 percent; in 6,177 cars without belts—48.7 percent. The percentage of cars traveling above 60 miles per hour was as follows: In 412 cars with seat belts—26.9 percent; in 6,177 cars without belts—25.1 percent.

Statistical tests have shown the differences between the cars with and without belts as regards speed are not statistically significant and are due to chance fluctuation. Using these data as criteria, it does not appear to us that seat-belt users are traveling faster as a measure of overconfidence engendered by seat belts.

May we conclude our presentation by again referring to the comments made earlier to the effect that it is not normally the role of automotive crash injury research to engage in controversy?

In this particular area, it is our opinion, based on the relatively massive evidence available, that seat belts are the most important single, economically feasible device available as a means of controlling trauma associated with automobile accidents throughout our Nation.

If belts can be accepted as producing a marked reduction in the risk of injury among people remaining inside the car and can be demonstrated as capable of bringing about a far greater reduction in the risk of injury when applied to those people who would be ejected without belts, we do not believe it necessary to hesitate in evaluating the criticisms of seat belts on the basis of facts observed on the highways.

We do not believe in, and have never presented, the concept that a restraining device is a panacea, a cure-all, or a never-fail solution for all accidents. We firmly believe that the seat belt is a sound, effective way of reducing one of our greatest public hazards. Again we maintain that safety—like law or medicine—must be provided so that its benefits will be available to the greatest number of persons and not denied to all because of occasional failings.

Mr. ROBERTS. Thank you, Mr. Moore. That has been a very wonderful presentation. Since we are pressed for time this morning, otherwise you could have had a more leisurely presentation, and we would have had time for an adequate question and answer period.

I would like to know again for the record how you collect your statistics upon which you base these opinions.

Mr. MOORE. These data are obtained by cooperative programs with the State police, the State department of public health and the State medical societies in some 15 States. Area data are collected for study on the basis of the similarity of this area and reproducing a pattern of accidents more nearly representing the pattern of accidents throughout the State as a whole. In these areas as each accident occurs it is reported to us by the State trooper on a form which is standard in all areas. This trooper in addition to the accident report photographs the vehicle. The medical data is obtained over the signature of the physician who treats the patient.

These data are forwarded to us and are analyzed by teams of analysts in each case being analyzed by two people independent of each other, to reduce to the minimum the subjectivity of the findings. And from this source, from this point the data is translated to IBM punchcards and have been used as a basis of the conclusions we have reached in this statement.

Mr. ROBERTS. How long have you been connected with the Cornell research project?

Mr. MOORE. I joined in May of 1953, sir.

Mr. ROBERTS. It has been continuing since that time?

Mr. MOORE. Yes, sir.

Mr. ROBERTS. I think, certainly, that has been a great public service in showing that a great deal of criticism of seat belts is based on mere opinion, and that some reports are not correct.

And I want to thank you for your contribution.

Mr. Rogers.

Mr. ROGERS. I have only one question. You showed a picture of a car up on its side on the ground. How did that car get beyond that little tree without knocking it down?

Mr. MOORE. I don't know, sir, except to say that in this area most peculiar things happen.

Mr. ROGERS. That is what I had in mind. You had a picture there that brought that out very well.

Mr. MOORE. It might have been straight up and come straight down like a helicopter.

Mr. ROGERS. The bark is knocked off the big tree, but not the little one.

Mr. MOORE. What slide was that? That was not bark.

On slide 10, the speed was reported at 90 miles an hour, impact 70 miles an hour.

Mr. ROGERS. That is not the one.

Mr. MOORE. It ran off the road into a 10-foot ditch, struck two trees and overturned on top and——

Mr. ROGERS. That is the one there.

Mr. ROBERTS. It pushed over the tree and snapped it back.

Mr. MOORE. The driver was projected through the windshield, center front passenger was not ejected, and the right front not injured or ejected. So two people——

Mr. ROGERS. Isn't that bark off the tree there at the right? Isn't that the bark off the tree?

Mr. MOORE. Yes, I judge it to be. The fact is that two people remained in the car and were not injured.

Mr. ROGERS. Thank you.

Mr. ROBERTS. Without objection the statement and charts and the graphs contained in the presentation will be made a part of the record.

We will ask permission of the House to sit this afternoon. We have one remaining witness in connection with this afternoon. That is Mr. Schrum of the Studebaker-Packard Corp. We will adjourn until 2 o'clock this afternoon.

(Whereupon, at 12:15 p. m., the subcommittee was recessed until 2 p. m., of the same day.)

AFTERNOON SESSION

Mr. ROBERTS. The subcommittee will please come to order.

Under the permission granted by the Speaker of the House, the Subcommittee on Traffic Safety will continue its hearings.

The next witness is Mr. Donald Schrum, of the Studebaker-Packard Corp., South Bend, Ind.

Mr. Schrum.

STATEMENT OF DONALD SCHRUM, REPRESENTING STUDEBAKER-PACKARD CORP., SOUTH BEND, IND.

Mr. SCHRUM. Mr. Chairman, I am Donald Schrum, representing Studebaker-Packard Corp., of South Bend, Ind. It is a privilege to appear before you again, Mr. Chairman.

With the expressed purpose of these hearings being an effort to determine the value of seat belts in accidents we have more to gain in knowledge of the subject than we can contribute. Our activities have been based on acceptance of facts from authoritative sources, some of which have already been presented in these sessions.

At Studebaker-Packard we have been dedicated to a policy of providing the utmost in safety that existing knowledge could define.

To that end we are constantly alerted to reports from all of the various research and factfinding agencies working in the field of vehicle safety. This has been expedited by our representation on the various industry committees such as the Society of Automotive Engineers seat belt committee.

These committees, while providing a common meeting ground for exchange and comparison of information by the various industry safety workers, also serve as a distribution point for many reports from agencies outside of the industry. In this way we have had the advantage of a broader scope of technical knowledge and facilities than anything available within our personnel and laboratory limitations.

Our investigations of seat belts were first prompted by the earlier work of Hugh De Haven, of the Cornell Medical College, whose conclusions were based on studies in aircraft accidents.

Further authoritative reports from the expanded Cornell operations under the direction of John Moore in cooperation with State police groups in several States emphasized the probability that the use of restraining belts could minimize injury. The work of Colonel Stapp, who I understand you heard earlier, gave an indication that in most survivable crashes the human body could withstand the loads imposed by belts.

These reports, which were based on the most valid approach, in spite of a conflicting public opinion, governed our decision to make available as an accessory, a seat belt designed for efficient use in our cars and conforming to the requirements of the SAE recommended practice for motor-vehicle seat-belt assemblies. These belts have been available through our dealers and as factory-installed accessories since the introduction of our 1956 models late in 1955.

Prior to introducing the belts tests were conducted to assure us that the body structure was adequate to withstand the loading imposed by the belts.

Various types of belt configurations were studied to find one that would offer the greatest advantage to the user. The type we selected provides an anchor for the outer belt to the lower rear edge of the door and uses a conventional airline type of buckle.

It was felt that any advantage of facility of use would encourage its use by the car occupant and this type of belt permits convenient stowage of the outer belt to a clip on the door, making it readily accessible for use at all times.

It was also recognized that anchorage on the door would not be affected by deterioration and weakening of metal as will occur at the outer edges of the car floor where many types of belts are anchored. The cam-type buckle was a logical choice for its simplicity which would require no instruction in operation and would produce the least amount of frustration for the new user.

No consideration has been given to making the seat belts a part of the regular car equipment because of the controversial aspects in the public mind. We are in a trial and educational period during which many people are using belts and their experiences in accidents, reported by the police and medical groups and correlated by the Cornell organization, are the test results that must be obtained before we can expect widespread public acceptance through knowledge of the proven benetfis to be obtained.

Mr. ROBERTS. Thank you, Mr. Schrum.

I want to tell you that the subcommittee appreciates your appearance here and the fact that you came from a long distance to be available to the committee.

I have one or two questions I would like to ask. First of all I am not sure that I understand the seat belt that your company recommends.

Is the outer belt attached to the door? I do not know if I understand that or not. You say anchorage on the door; do you mean that part of the belt is attached to the door?

Mr. SCHRUM. That is correct.

Mr. ROBERTS. I assume that would be the lower portion of the door?

Mr. SCHRUM. That is correct.

It is attached to the door in a position which would produce a comparable alinement to the passinger using a floor anchorage.

However, it is placed on the door to prevent the belts from being a nuisance, let us say, laying in the seat, falling out onto the ground from the seat, and so forth. We felt that the facility of use provided by such an arrangement might overcome some of the drawbacks and objections that some of the abstainers might raise.

Mr. ROBERTS. Is that portion of the belt in a reel-type container, or is it retractable?

Mr. SCHRUM. No, sir, it is not retractable. It is fastened to the door, and the belt is still extended to its full length. But there is a clip provided on the door which allows you to fasten the loose end of the belt when not in use to the face of the door, so that it is readily accessible.

Mr. ROBERTS. The left-hand part of the belt on the driver side and the right-hand part of the belt on the passenger side would be attached to the left and right doors, respectively?

Mr. SCHRUM. That is correct.

Mr. ROBERTS. And you, I believe, say that you do now install that as an accessory where it is paid for by the customer?

Mr. SCHRUM. That is correct.

We have factory installation available. I might expand on that a little bit and say that in the early days of our use of seat belts, our dealers made quite full use of that facility in our factory.

However, I cannot quote any figures, but I can say definitely that has been considerably diminished in the last few months. The dealers are making most of their own installations.

Mr. ROBERTS. Do you have any estimate of what percentage of your 1956 models were equipped with seat belts, that is, as to the front seat?

Mr. SCHRUM. I have a figure that may or may not be accurate. But it is the closest that I could approach from the multitude of sources that I had to get my information from.

I find that based on the reasoning that we used in analyzing these figures, we apparently have sold front-seat belts equivalent to 3.8 percent of our production of the entire 1956 and to June 30 of 1957 models.

Now, I can expand that further and say that I have no way of knowing that these seat belts that were sold were entirely applied to our cars. That is only a figure that we can arrive at—3.8 percent.

Mr. ROBERTS. I think that is a bit higher percentage than has been given in testimony by any of the other segments of the industry.

Mr. SCHRUM. I recognize that, sir.

Mr. ROBERTS. It is encouraging.

Thank you very much, Mr. Schrum. And it has been a pleasure to have you appear before the subcommittee, and we are glad to see you again.

Mr. SCHRUM. Thank you for the privilege.

Mr. ROBERTS. Now, this morning Mr. Severy of the Institute of Transportation and Traffic Engineering of U. C. L. A. had a film that we were not able to see this morning. If he would like to proceed with that now, we can have that film presented now.

STATEMENT OF DERWIN M. SEVERY—Resumed

Mr. SEVERY. Thank you, Mr. Chairman.

I would like to explain that these are edited high-speed film sequences, except for the first sequence, which is a normal speed.

Since the experiments were run just last month, I have not been able to have sound dubbed in. So, I will read the narrations in correspondence to the sequences.

Mr. ROBERTS. That will be fine.

The reporter can take it as you deliver it.

Mr. SEVERY. First we have a brief scanning of the test site. We have the vertical camera tower situated over the impact point, seen as the camera sweeps toward the oncoming Pontiac crash car.

The push car, a Chevrolet station wagon, is seen breaking away from the power car after the predetermined speed has been reached.

Note the extreme elevation of the rear end of the crash cars as they crash, which has already happened, and the fact that they rotated about the vertical axis during the impact.

There are some lateral or spin effect there. The head of the Pontiac driver is seen beside the door of the Nash. You will have another opportunity to see that.

Fire-protection facilities were provided by the naval base.

In the next sequence, the restrained rear-seat occupants are seen pitching forward also. In this crash the rear-seat occupants are wearing a double lap-type belt unit with a total loop strength of 16,000 pounds.

The belt unit, which did not fail, succeeded in tearing the floor pan loose in the vicinity of one side of the anchorage area.

Their heads remained in view throughout the impact, because the lap belts continued to exert a degree of restraint sufficient to prevent their heads from striking the instrument panel.

Note the decapitated head from the Pontiac driver striking the pavement adjacent to the Nash windshield. That is the car on the right.

We will see more views of this and the situation will become a little clearer as we see other sequences.

This is 50 miles an hour. Two cars crash head on with a 1-foot offset from a direct head-on collision.

We are looking from the Pontiac back seat here. This is at a rate of 50 miles an hour. This camera is located on the rear shelf looking forward. The cars approach each other.

The force of the impact momentarily depresses a camera mount which we will see in a minute as the driver is crushed against the steering column. Then the camera comes back up to register what happens within the car.

The rear-seat dummy is seen pitching forward and upward into the rear end of the car, having vertical motion. He then is returned by the restraining belt approximately to his precrash position.

On this view we see the Pontiac on the left and the steering-wheel column elevated straight upward and forward out of the range of the driver during initial stages of impact before the driver is forced forward.

The bright flash in the back of the Pontiac is the auxiliary lighting unit facilitating high-speed photography on the shady side of the collision.

You can see the effect of that. You can see the bright light under the Pontiac right now. This is the car on the left.

You can see that the narration has not been dubbed too carefully to the length of the sequence.

You can see the Pontiac rotating toward us. That is the dark car on your left as it is settling toward the ground again.

That is due to a 1-foot offset that we introduced into the experiment.

Incidentally, we are crashing these cars with the precision of not more than 12 inches lateral displacement from the preassigned impact point, and not any detectable displacement in the other axis.

Here we have a closeup now of the cars, showing the rear seat occupant crowding against the front seat and crushing the driver further. You notice that the cabin area around the driver has been diminished so that survival in this condition appears extremely doubtful.

There just is not volume left there to permit life to exist during the brief moments when the car is fully compressed. That is speaking only of the driver section there.

In the rear seat area we will see a vertical shot in a minute in which the individual was able to stretch the belt forward and come back into his seat without any observable significant damage to the dummy, in spite of the extremely high loadings.

I will indicate that there are in excess of 10,000 pounds. We have specific readings, but we have not cross-correlated them with any other instrumentation. So, I would rather speak in a general manner at this time.

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This is a vertical high-speed camera looking straight down. You can see the cars pressing together. That is the rear seat occupant on the right driving into almost the instrument panel, but not quite.

There goes the head of the driver on the right into the instrument panel of the car on the left and bouncing off. You can see it on the edge there.

Mr. ROBERTS. Each car was at a speed of 50 miles an hour?

Mr. SEVERY. Yes, sir.

And they were completely independent of their steering. That is, a guide and speed-controlling influences, at the time of impact. This was just part of the engineering system which I would be glad to explain if it is of any advantage afterward.

The cars were crashing under completely, you might say, normal conditions, duplicating a situation that we might expect out on a highway where two people attempt to pass and there is not clearance, coming head-on.

I believe we have one more sequence in which we will be looking on the shady side of the crash cars. And we will see the auxiliary lighting come on, which facilitates our micromotion analysis of the film sequences from a general observation point of view. It allows the person to see the extreme collapse of the structure around the driver which leads to a severely diminished volume of the driver compartment.

Watch the right side here. You can see that the driver compartment is very severely diminished in volume. Depending on which side you look at it from, the car on the left looks more severely crushed. This is due to the 1-foot offset where the floor system is different on the corresponding side of the car.

You can see the cable which carries the electrical information back to duplicate instrument recording systems that were mobile and followed fairly close to the crashing cars.

I have an additional film which I do not wish to monopolize time with. However, I do feel that if we have time this afternoon, it would be to the interest of the committee to see the film.

Mr. ROBERTS. Fine.

Mr. SEVERY. The reason I would like to emphasize it is that this is our first attempt to film what I consider a void in this entire safety program for reducing auto or motorist collision. This I refer to as the educational aspect of the motoring public. We feel that we have had spendid cooperation from the automotive manufacturers. There is certainly a sincere effort to improve the situation. We were able to see in the past couple of years the lack of corresponding effort on the part of perhaps organizations like our own to back this industry approach with a medium of education that would facilitate its acceptance.

I feel that the film which we have called Impact is a step in that direction.

I recognize that considerably more can be done.

The footage that we have gained from 12 head-on collisions in the past year will also be incorporated into a film that I think will be even better than this one. But I would like to introduce this film as a first attempt in this direction.

This is a 12-minute film with sound. It is being released at the moment throughout the country through all the groups that repre-

sent normal channels. An example would be the driver training groups on the high-school level, through safety organizations, PTA's, and probably will be seen on television. At least we hope it will receive that wide coverage in order to maximize its presentation.

Mr. ROBERTS. I believe your State has a driver education program in its high schools, does it not?

Mr. SEVERY. Yes, sir, we do.

Mr. ROBERTS. A State program?

Mr. SEVERY. Yes, sir.

As a pilot study, we had a group of 30 of the educators witness this film. And it received tremendously favorable reactions. They immediately wanted copies. So, I feel they will do some good.

(At this point, the film Impact was shown.)

Mr. ROBERTS. Thank you, Mr. Severy.

Mr. SEVERY. That completes our presentation.

Mr. ROBERTS. Before concluding, let me say this: This morning I didn't have an opportunity to ask Mr. Moore any questions. If he would like to submit to some questions, I would be glad to have the hearings continue for that period of questioning.

I have some questions I would like to ask you.

STATEMENT OF JOHN O. MOORE—Resumed

Mr. ROBERTS. First of all, Mr. Moore, from your experience how long should a belt be used before it is replaced? Or about what is the life of that belt?

Mr. MOORE. Congressman Roberts, I honestly do not know the answer to that question.

I am personally concerned with it in my own vehicle. The belts in my vehicle have been used for approximately 21 months at this time, and I noticed evidence of fraying around the portion of the belt which fits through the cam-type buckle that I have on my car. I feel that there is some definite need, a very urgent need, for some review of this problem. And the knowledge of this should be used along with the knowledge we have about the specifications when it is new.

The only experience I have had that might be useful in bearing on this question is the experience we had with the military services where we required that all restraining devices be removed and tested at periodic intervals and the date of testing be stamped on the restraining device.

This is something which perhaps can best be considered by the Society of Automotive Engineers' Committee on Seat Belt Standards.

I do feel personally that I would like now the opportunity of having some reliable industry take the belts from my automobile, which is showing signs of fraying and slippage of the buckle and test it for its capacity against the original specification. This is a matter which has not yet been considered to the best of my knowledge.

Mr. ROBERTS. Do you have any recommendations to make as to the type of buckle that is preferred on the belts?

Mr. MOORE. This takes me into an area of engineering. And I feel I am incompetent to comment in this area other than philosophically, and to this extent I would remark that I would desire that if engineering standards can be maintained, that a buckle be designed that has

the lowest nuisance value. It is obvious that a buckle which is fitted to the size of the user who constantly uses a belt which snaps into place would present less nuisance value.

I make this recommendation only if engineers could assure us that such a device would have the same efficiency as the cam-type buckle.

Mr. ROBERTS. Now, during the hearings, we have had, I think, almost an overwhelming amount of testimony to the effect that seat belts were good, but that it is a matter of public education.

Do you have any suggestion as to how we can promote the use of seat belts?

Mr. MOORE. I would say, sir, that the first step in the development of any educational program is the acquisition of knowledge which is acceptable for educational purposes. I would hope that the next step that could be taken is that there could be agreement among the scientific groups who get this knowledge as to an acceptable method of translating the knowledge into those terms which we could hope would most nearly or most efficiently affect the daily behavior of the people we were discussing the matter with.

I am of the opinion that people respond when the knowledge they are given is translated into those terms that do affect their daily behavior pattern. I believe we need the best available assistance from our educational colleagues as to the best way to do this and still remain acceptable to the scientists who have completed the data.

I feel that the insurance companies have a unique opportunity in this area. I refer specifically to the educational impact that is maintained by, say, the health and education program of the Metropolitan Life Insurance Co. I have had the experience that wherein the knowledge of crashes and the forces involved are used in driver-education programs, that it does a great deal to convince the student that he, as a learner, is handling quite a lethal degree of force. I have found that it many times impresses him that this is not something that he can take lightly as a course for fun.

This again, is an illustration of the way I think an educational program can be undertaken. In addition, I believe that the resources available to the advertising geniuses of America are particularly efficient.

If they can prevail upon us, as citizens of this country, to buy almost anything and to extend our credit to way past the breaking point, I am sure they could prevail upon us to take steps in the interest of our own protection.

Mr. ROBERTS. Do you think that the manufacturers, through their dealer contracts, could perform a public service in this field?

Mr. MOORE. Sir, I would venture the opinion that between the combined resources of salesmen, who sell automobiles to customers on the showroom floor, and physicians, who treat patients, between these two organizations, as organizations of professional people, we have a unique opportunity to influence the buying and thinking habits of the American public.

I believe that of all the organized professional groups, organized medicine has one of the most unique opportunity in this direction. I refer to the impact which the medical profession has had on the American public in convincing it of the validity of using Salk vaccine as a means of protection of its children against possible infection by

poliomyelitis. We, as the citizens, hold our physicians in a special regard, as we hold our ministers. And it might be wise to consider the impact which the profession might have in an educational program in this direction.

Mr. ROBERTS. Have you any personal knowledge of the efforts that have been made by the American College of Surgeons and the American Medical Association in committees with reference to endorsement or promotion of the wearing of seat belts?

Mr. MOORE. Yes, sir.

The American College of Surgeons, I think, was the first of the organized medical groups to recommend directly to the manufacturers the desirability of providing this device. And through their efforts, an educational program of some sort has been undertaken.

The American Medical Association has organized, under the direction of Dr. Fletcher Woodward of Charlottesville, Va., a committee on this problem. And I have had the pleasure of participating frequently with the committee of the American Medical Association on traffic accidents and deaths. And I am a consultant to the committee on trauma of the American College of Surgeons.

I have been invited to participate in the American Medical Association committee. I know that the American Medical Association committee at the moment is considering the desirability of reducing to published form existing knowledge in three areas regarding this problem, and is seeking for financial support to distribute the published booklets in sufficient quantities that each physician in the country may eventually have a supply furnished to his patients as they call at his office.

This, I think, is a very important opportunity that they have seen and have taken great advantage of.

Mr. ROBERTS. The statement has been made in the hearings that seat belts may be of help in an accident where the cars are traveling at slow speeds but not at high speeds. If this is the case, in order to evaluate how effective a seat belt might be, can you state how many accidents occur in the different speed ranges? I mean from the figures that you have collected and from the statistics that you have studied.

Mr. MOORE. First, I think I should say for the record that the engineering criticism of a research program of the nature that we operate might be considered and should be considered as valid in that we do not know exactly or precisely, because of the absence of instrumentation, the speed ranges of cars driven over typical highways by humans. Our data is, and must be, considered subjective; but there are techniques of validation of that data.

If the reported speed of the vehicle is accompanied by photographic evidence of deformation of structure, it is possible to compare the photographic evidence of deformation with photographic evidence of deformation of research experiments conducted by our colleagues in the engineering field. This provides a standard or a criterion that is acceptable within certain limits.

It has been our observation, our published observation, that 50 percent of the injury-producing accidents that we have, as the evidence that we have accumulated indicates, are accidents in which the speed at impact was less than 41 miles an hour on open highways.

In urban accidents, the 50 percent brake point is at 27 miles per hour. We have observed from our data, with its reservations, that in 69 percent of the injury-producing accidents, the speed is less than 50 miles per hour at the moment of impact.

This encourages us, because when our data on speed is compared with our estimates of deformation of structure, it indicates that the package around the goods is holding up remarkably well, in that in the bulk of our injury-producing accidents, the severity of damage to structure is in the moderate to severe range; that is, moderate or minor damage. It indicates that the American public is not traveling in its vast majority at truly reckless speed on our highways.

We have compared the distribution of our speed data with that which is maintained by the United States Bureau of Public Roads. And their data is obtained from mechanically recorded unobserved speed checks in straight open stretches of road with no enforcement vehicle in the vicinity to deter the motorist from his normal driving speed condition.

Mr. ROBERTS. Further expanding on the matter of terrain, what percentage of injury-producing accidents occur on rural or open roads in comparison to metropolitan or controlled areas?

Mr. MOORE. It has been our observation that the more severe grades of injuries are associated with open, nonurban, or what we would term "rural," by definition, roads. By this we mean outside the corporate limits of a city and unzoned speed areas, up to the legal limit. That is where the bulk of the trauma that we have occurs; that is, the more severe degrees of trauma.

However, when we did get urban data and were able to contrast urban injury-producing accidents with rural injury-producing accidents, we found that with the exception of minor grades of injury and fatalities, the frequency of the moderate to dangerous grades of injury; that is, those grades of injury which would hospitalize a patient, were equal, statistically. There was a significant difference in the frequency of "no injury" accidents, which favored the urban accidents; and there was a statistically significant difference of fatal injuries, which favored—if we may use the term "favored"—rural accidents.

Medicine is not nearly as concerned with these two grades as it is with the intermediate grades. The intermediate grades are just as likely to be seen in the city accidents as in open highway accidents, which leads us to the conclusion that, without doubt, injury is primarily a product of the design of the interior component which the human hits. If it can be altered to bring it within the range of tolerances which Dr. Stapp has described, I am convinced we can do immeasurable good in this area.

Mr. ROBERTS. Well, I take it that you believe that through engineering research and study a safer package for the passenger can be designed by the industry than is presently available?

Mr. MOORE. I think it is true not only in this field, but it is true in the field of medical treatment of any disease.

There are improved techniques of surgical procedure that are available to treat cases once they occur. I think there is a vast improvement available in this area, provided those people who are charged with the responsibility of making the design changes have the best

available support from their scientific colleagues who supply them with parameters of design. I believe it will occur only as a team effort, and only if mutual respect continues.

Mr. ROBERTS. Do you think a trend is developing that indicates the public may demand a better package and more safety in design in the future than they have had in the past?

Mr. MOORE. I would suggest, sir, that those Members of Congress, or those in political life, are more able to answer this question than I.

I am not aware of any special qualities I have for anticipating what the public may want. I have only the opinion that this matter has come into sharp focus to the public in recent years in greater degree than it ever has been in the past. And there may be a cycle in time where it is proper for certain things to be acted on.

Mr. ROBERTS. Well, I recall that not so long ago at the Governor's conference, the President was very much of the opinion that there has been pretty much of a vacuum in this field of traffic safety.

I think he had reference primarily to the legislative action of the States. And I believe he stated that in his opinion it was a field primarily which called for State action, but that if the States did not move into this field in a manner that would cut down this painful toll that there would be some Federal action, unless something is done about this problem by the States. He did not say that he favored Federal action, but he more or less prophesied that there would be some Federal action unless something is done by the States.

I am getting away from the safety package idea over into the various legislative action that may be imminent.

The statement of the President indicates to me that there is the growing demand on the part of the public that something be done about this terrific toll of lives that is taken very year.

One more question, and then I will conclude.

Do you think insurance company rates might be lowered if larger numbers of the public used seat belts?

Mr. MOORE. I believe, sir, that the insurance rates are governed by law, with relative frequencies determining the increment or decrease of rates.

If engineering changes or restraining devices can be demonstrated on an actuarial basis to have decreased in frequency, then it follows automatically that rates should drop. At present, in some insurance companies which have offered a decrease, it applies only to those sections of the insurance premium which deals with medical coverage against injury. It does not have a bearing with regard to collision or the possibility of damage to property or persons by the vehicle.

These rates will drop as we are able to reduce the frequency of the first accident of the vehicle, just as medical rates would drop. I would ask liberty to comment on your previous question. That is that I would hope that any legislation, like any engineering change affecting any of the components of this area, could be based on knowledge rather than opinion as so much of it has been in the past.

I believe that the Federal Government can play a most important role through its executive branch, which, at present, seems to be the United States Department of Public Health, in providing research support for the acquisition of the knowledge we so badly need to predicate both legislation and engineering change on.

I am at present dealing with one of the most important problems that the American public faces, that of man and his motion. Changes which might be made from a standpoint of opinion and prove to be bad changes in highway design will very likely remain with us for the next 30 or 40 years once it is improperly designed, and designed without property knowledge.

I would hope that before we consider radical changes in either highway design or vehicle design or laws regarding the governing of issuance of permits to drivers that we could enlist the aid of the best brains that our country has to offer in order to get the best knowledge, and on this knowledge predicate our changes.

Mr. ROBERTS. What impact do you think the new interstate highway program may have on safer highways?

Mr. MOORE. I am aware that a study has been conducted by the United States Bureau of Public Roads which is to be reported to the Congress on January of next year. And I am not aware of their findings at the moment. I think that we are more aware of the need for designing the highway safely as well as efficiently from an engineering point of view now than ever before. And I believe that we are very likely to come up with the best solutions to means of transporting man and goods from one area of the country to another safely.

Mr. ROBERTS. I have been somewhat encouraged by the fact that according to the National Safety Council estimates, we are a little bit below what we were this time last year in numbers of fatalities. And perhaps that is true also of injuries. However, it is my own opinion that the impact of the Highway Act of 1956 will be a long time in making any substantial contribution. It is hard to assess just how much uniformity it will bring about on the part of the States.

I think, undoubtedly, it will have some influence.

Mr. MOORE. This problem, sir, is not very different from the impact which the installation of door locks and padded interiors will have on this second problem. At present only a few of our automobiles possess these advantages.

Mr. ROBERTS. A very small percentage.

Mr. MOORE. So that since accidents and injuries from accidents are somewhat a direct result of exposure, if we have a small segment of the population exposed to these advantages, it will be a while before we can measure any dramatic reduction in the use of old cars without these advantages and the increase of new cars with these advantages. The same thing will apply, I estimate, in the case of highways, as we have millions or hundreds of thousands of miles of highway without this degree of engineering knowledge.

If the public does the bulk of its traveling on these highways, rather than the new highways, it will be some while before we see the effect. Or, if the public, as I personally have just finished doing, selects the turnpike method of driving, of course, the effect will be seen sooner. I think we will see a dramatic reduction in the incidence of certain events very soon.

Mr. ROBERTS. Do you have any estimate of how many more vehicle miles we will drive in 1957 over what we drove in 1956?

Mr. MOORE. I do not think anyone in the world has a crystal ball that could estimate that.

Mr. ROBERTS. The reason I mention that is that I noticed the other day an estimate that we would drive about 15 billion more vehicle miles in this country in 1957 than we did in 1956.

Mr. MOORE. I have seen an estimate expressed in terms of percentage. It was associated with the Nation Safety Council's latest release. The estimate was that travel this year is up 5 percent or more than it was last year. The last informed people I have been able to talk to estimated that this is an increasing spiral, and as man buys cars and pays money for them, he is not going to buy it to put in the garage; he is going to buy it to drive it.

As our social order expands, along with our economic order, we will see certainly more travel. But no one ever anticipated the growth of our vehicular population between 1946 and 1956 to the extent it reached. The best estimates I have heard expressed seem to indicate that we will have approximately 70 million passenger vehicles on our highways by 1970 or 1975.

That is a considerable increase over where we stand now. As these vehicles are bought I am sure they are going to be used in traveling.

Mr. ROBERTS. Thank you very much, Mr. Moore.

If there are no further witnesses, that concludes the hearings on seat belts.

And I wish to thank all of the witnesses who participated in the hearings.

I wish to thank the staff and the press and all who have shown an interest in this subject.

The subcommittee stands adjourned.

(The following letters were received, at the request of the subcommittee, from States which have installed seat belts on some or all of their State-owned cars:)

STATES IN WHICH AUTOMOBILE SEAT BELTS ARE REPORTED USED BY OFFICIAL AGENCIES

State and Agency

Arizona: State highway patrol.
Arkansas: State highway patrol (in part).
California: State highway patrol and other departments.
Colorado: State highway patrol.
Connecticut: State police.
Illinois[1]: State police.
Indiana: State police, State health department, and other departments.
Kansas: State health department.
Massachusetts: State police.
Michigan: State police.
Minnesota: State highway patrol, State health department.
Missouri: State highway patrol, State health department.
Nevada: State highway patrol, State health department—optional with others.
New Mexico: State highway patrol.
North Carolina: State highway patrol, State health department, optional for other agencies.
South Dakota: State health department and other agencies.
Texas: Department of public safety.
Utah: State highway patrol.
Wisconsin: Motor vehicle enforcement division and others.
Wyoming: All leased cars.
Alaska: Territorial police.

[1] A State law, effective July 1, 1956, requires all new cars sold in Illinois to be equipped for ready installation of seat belts.

ARIZONA HIGHWAY PATROL,
Phoenix, Ariz., July 30, 1957.

KENNETH A. ROBERTS,
Chairman, Special Committee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR MR. ROBERTS: This letter is in reply to yours of July 19, 1957, regarding information on the use of seat belts in vehicles of this Department.

We feel that these seat belts have been very satisfactory, but fortunately we have not had any definite accident cases which would bear out this feeling.

We have for some time cooperated in the Cornell automotive crash injury survey and our investigative reports for this survey show seat belts definitely are a deterrent to serious injury in that they eliminate in many cases the ejection of occupants from vehicles.

Our major difficulty is one which we feel is possibly the same problem which many organizations have, and that is having the seat belts used and in operation after they have been installed.

Yours very truly,

G. O. HATHAWAY,
Superintendent, Arizona Highway Patrol.
By T. H. MILLDEBRANT,
Patrolman Operations Office.

DEPARTMENT OF ARKANSAS STATE POLICE,
Little Rock, Ark., July 25, 1957.

MR. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety,
Committee on Interstate and Foreign Commerce,
House Office Building, Washington, D. C.

DEAR MR. ROBERTS: Have your letter under date of July 19, reference safety belts being used in our patrol cars as a safety measure to our State troopers while on patrol duty.

In 1955 we had 16 patrol cars equipped with safety belts; 1956, 7 more of our cars were also equipped with the above. But since that time some of the 1955 cars have been sold, and new ones have replaced them and have not been equipped with belts.

We find from the use of these belts our patrolmen are better protected from injuries or death when they use them, also from checking accidents reports that are sent the record bureau that many persons could have escaped injury if they had had safety belts in use at the time of the accident.

Trust the above information will be of some help to you and your committee, I am,

Sincerely,

HERMAN E. LINDSEY,
Director.
By JACK RHEA,
Captain, Safety Division.

DEPARTMENT OF CALIFORNIA HIGHWAY PATROL,
Sacramento, July 30, 1957.

HON. KENNETH A. ROBERTS,
Representative in Congress,
House Office Building, Washington, D. C.

MY DEAR MR. ROBERTS: In the absence of Commissioner Caldwell, your communication of July 19 asking for our experience in the crash worthiness of automobile-safety belts has been referred to me for reply.

The California highway patrol first commenced equipping its automobiles with safety belts in 1953. Coincidental with the installation, an order was issued recommending the use of the safety belt at all times but particularly during emergency operations. Arrangements were also made to record all accidents in which the use or nonuse of the safety belt was a factor.

Within the first few months of commencement of the program several incidents occurred wherein the officer driving the vehicle was saved from serious injury and possible death by the use of the safety belt. As a result, our order was changed to require the use of safety belts at all times while operating a California highway patrol vehicle.

The California highway patrol intends to continue the installation and use of safety belts. A California State law now requires all safety belts sold in the State of California to meet strength and safety specifications established by the California highway patrol. A copy of the specifications are attached. A directive of the California State department of finance also requires safety belts to be installed in all vehicles operated by the State, regardless of the department, and that operators and passengers fasten the belts whenever they are driving or riding as a passenger in the cars.

Respectfully yours,

ROSS R. MCDONALD,
Deputy Commissioner.

DEPARTMENT OF CALIFORNIA HIGHWAY PATROL SPECIFICATIONS FOR SAFETY BELTS TO BE USED IN CALIFORNIA HIGHWAY PATROL VEHICLES, JUNE 20, 1957

1. The safety belt shall be of a make and model for which a California highway patrol certificate of approval has been issued prior to the submission of the bid.

2. In addition to the above requirement the belt shall comply with the following specifications:

(*a*) *Buckle*

(1) The buckle shall be either the metal-to-metal or the metal-to-webbing type.

(2) The length and shape of the release handle shall be such that the buckle cannot be inadvertently released by being caught on the sleeve of an officer's coat or on the gun belt and its attachments.

(3) The buckle spring shall be protected against breakage or overstressing when the release handle is forcibly opened to its maximum position.

(4) The buckle tongue of metal-to-metal buckles shall be symmetrical so it can be inserted upside down without affecting the strength of the fastening.

(5) The pin holding the release handle to the base shall be secured in such a manner that it will not come loose when the buckle is dropped or when the pin retainer is hooked or caught on an object.

(*b*) *Length adjustment mechanism in buckle*

(1) The length of the belt shall be adjustable in the buckle.

(2) The end of the webbing attached to the buckle tongue of metal-to-metal buckles shall not be adjustable but shall be looped and sewn or otherwise permanently attached to the tongue.

(3) The belt shall be capable of being easily tightened by one hand without the buckle being inadvertently released.

(4) The adjusting mechanism shall be constructed so the webbing will not slip in the buckle until the angle between the loaded section of the webbing and the base of the buckle is at least 60°.

(5) The adjusting mechanism of metal-to-metal buckles shall hold the buckle at the same position on the webbing without sliding out of adjustment when the buckle is released.

(*c*) *Floor mounting bracket*

(1) The mounting bracket at each end of the belt shall employ a single bolt and require the drilling of only one hole for attachment to the floor of the vehicle.

(2) Each end of the belt shall be adjustable in length at the floor bracket unless the belt is supplied, in the exact length required for installation in highway patrol cars.

(3) The bracket assembly shall be so constructed and the webbing so threaded that the webbing will not loosen or change adjustment without a manual operation.

(*d*) *General construction*

(1) There shall be no sharp edges or protrusions which might abrade or catch on clothing or produce injuries to the occupants of the vehicle.

COLORADO STATE PATROL,
Denver, July 30, 1957.

Hon. KENNETH A. ROBERTS,
United States Representative,
Committee on Interstate and Foreign Commerce, Washington, D. C.

DEAR SIR: I have you letter of July 19 requesting information on the use of seat belts in the State patrol fleet.

At present we have only a few vehicles that are equipped—scarcely enough to have formed any opinion. We do, however, have belts on order for all of our cars, but it will take more experience before I could offer any logical comments.

I do have some suggestions to offer with regard to other phases of traffic safety that you may want to consider.

First of all, it seems to me that one of the more important factors in the traffic-safety program is an improved comprehensive driver-licensing system. By this I mean complete examination of every new driver and periodic reexamination of every new driver to eliminate all mentally and physically unfit persons from behind the wheel. In conjunction with this, current and complete driver-licensing and accident-records systems that can be used by enforcement agencies, the courts, and administrators of the system for the purposes of equality of penalties, suspension and revocation of licenses, and by traffic and highway engineers.

In my own State, and others that I know of, the traffic courts, in many instances, fall far short of the institutions of justice that the people are entitled to.

Our archaic traffic-court systems, in my opinion, are in urgent need of revision to cope fairly with today's traffic problems.

Enforcement agencies throughout the country are handicapped by lack of adequate personnel to meet the growing burdens of constantly increasing vehicles, drivers, and miles of travel. But even with adequate manpower—a remote possibility—police agencies would remain only partly efficient unless driver licensing and traffic courts were improved to perfection.

These are only a few of the things that in my opinion deserve consideration. There are many aspects to each of them that need improvement, but these corrections could be made, and I am sure would have public approval.

Yours very truly,

G. R. CARREL, *Chief.*

STATE OF CONNECTICUT,
DEPARTMENT OF STATE POLICE,
Hartford, Conn., August 2, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D. C.

SIR: Confirming your request by letter of July 19, 1957, please find enclosed a statement regarding the experience of the Connecticut State Police Department in the use of seat belts in patrol cruisers.

You have my permission to incorporate my report in the official record of your subcommittee's report on seat belts.

If I may be of further assistance to you in the matter, please advise.

Sincerely yours,

JOHN C. KELLY, *Commissioner of State Police.*

REPORT ON USE OF SEAT BELTS, CONNECTICUT STATE POLICE DEPARTMENT

In June 1954, the Connecticut State Police Department began participation in the Cornell University Medical College automotive crash injury research project. Since that date over 500 accidents have been investigated, photographs taken, and lists of injuries and their causes have been documented. The Connecticut State Medical Society, through its member doctors, has submitted medical reports covering injuries produced in these accidents. These total data have been submitted to the Cornell research staff for analysis.

Work in such a program clearly demonstrated the need for necessary improvement in motor-vehicle design to cut down or eliminate many of the injuries observed by our investigating officers. It became obvious that many of the objects

ahead of occupants in passenger cars were designed with little consideration of their injury-producing potential and were in many instances quite lethal. Our police patrol cars were no exception.

Individual officers began to install improvised belts in many of the patrol vehicles. This was prior to the time such belts were offered as optional equipment by the Ford Motor Co., whose equipment is used by this department. None of these belts were tested to ascertain whether or not they conformed to the recommended specifications as set forth by the Cornell Aeronautical Laboratory and no vehicle with such belts installed was involved in an accident.

In the fall of 1955 this department began to acquire vehicles with factory-installed seat belts for both front seat occupants. Officers were ordered to use the belts while on highway patrol. A total of 224 patrol vehicles were so equipped during the following year. During the current year 50 more new cars were purchased with such seat belts installed so that this department is now operating a total of 274 patrol vehicles with factory-installed seat belts.

The belts have been accepted without question by most of the State policemen. However, a very few officers consider them as an unnecessary nuisance. Full acceptance followed rapidly in stations where officers' lives have been saved by such belts. Contradictory publicity on the value of such belts appearing in various news media has served to confuse the picture somewhat, but no amount of such publicity can change the fact that the lives of three officers have been saved by such seat belts.

In the three cases mentioned above, the officers involved in the accidents have stated that they have no hesitation in asserting that the use of the seat belts prevented serious, if not fatal, injuries. Several other less serious accidents have been recorded in which seat belts were being used by police officer operators, but the minor nature of the accidents made it impossible to assay the effects of the belts in preventing injury.

The Connecticut State Police Department will continue to increase the number of vehicles equipped with seat belts as new cars are purchased until such time as every patrol vehicle will contain such belts. We are convinced that these belts are an important item of safety equipment and will prevent a great many of the minor, serious, and even fatal injuries observed in everyday accidents.

The belts are particularly important in the many accidents in which vehicle occupants are thrown from the car and onto the highway or under the rolling automobile. Many times such accidents are of a minor nature as far as impact speeds and vehicle damage is concerned, but such ejection results in fatal consequences. Eighteen such fatal accidents have been investigated during the crash injury research program and these loom large in the minds of the police executive who is called upon to evaluate the effectiveness of auto seat belts. More effective door latches may cut down the need to secure passengers in vehicles to prevent ejection. However, we have not yet seen the use of such safety latches on a sufficient number of vehicles to reach this objective.

Another factor which has not been given much consideration is that these belts may prevent a loss of complete control of a vehicle by keeping the operator behind the wheel where he can continue his efforts to control the car. When a vehicle strikes a curbing or a rough area adjacent to the highway while moving at superhighway speeds, the operator may be thrown out from under the steering wheel and thus cannot guide the vehicle. This is true in any such mishap, but is particularly true for the police officer who frequently is required to operate at high speeds in the line of duty.

Many police officers have also noted that seat belts help to reduce fatigue. When properly adjusted the belt will keep the officer in an erect position and legs can be relaxed as there is no need to exert constant leg pressure to maintain his position. During long hours of patrol such added comfort is an important factor in cutting down fatigue.

Efforts to promote the use of safety belts by police safety officers has been somewhat obstructed by undue publicity given to cases in which some "authority" maintains that the seat belt was the direct cause of death in a particular case. One such case in Connecticut was featured in news stories when a county coroner made such a finding. Cases in which seat belts saved persons from serious injury or death are not so featured. As one reporter stated, "We have such cases every day on the stock car racing tracks. Belts saving lives is 'old hat,' but belts resulting in injury or death is news."

The Connecticut State Police Department does not contend that automobile seat belts are a panacea either for its own officers or for the general driving and riding public. We do contend that the widespread use of properly installed and adjusted belts would materially reduce the number of injuries and deaths in our mounting toll of highway accidents. Such belts have been effective in saving at least 3 Connecticut State policemen from serious injury or death in less than 2 years, and this department will continue to use the belts in our own vehicles and will continue to urge their use by the general motoring public.

JOHN C. KELLY,
Commissioner, Department of State Police.

DEPARTMENT OF PUBLIC SAFETY,
STATE HIGHWAY POLICE,
Springfield, Ill., September 6, 1957.

Hon. KENNETH A. ROBERTS,
Congressman, House Office Building,
Washington, D. C.

DEAR CONGRESSMAN ROBERTS: Replying to your inquiry reference the use of seat belts by the Illinois State highway police cars, please be informed that we have been using this equipment since 1955 and believe that they are most helpful in preventing serious injuries in cases of accidents where car doors are sprung open.

We are at the present time enlarging our force by 500 men which will require a large number of additional cars which will all be equipped with safety belts.

Very truly yours,

WILLIAM H. MORRIS, *Superintendent.*

INDIANA STATE POLICE,
Indianapolis, Ind., August 22, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR REPRESENTATIVE ROBERTS: All of the Indiana State police patrol cars have been equipped with seat belts for some time. All of our cars now purchased are equipped with seat belts and padded instrument panels. These requirements are based on our findings of our auto crash injury research data.

Our troopers are also completing a detailed seat belt report whenever a car involved in accident is equipped with seat belts. Such report is required whether occupants were or were not using seat belts at time of impact.

We have had six of our cars involved in accidents, some of them of a more serious nature. Not one trooper was hospitalized. All were wearing seat belts.

All information herein is from Indiana data only and is separate and apart from the interstate study, although they are similar in many ways.

Our data substantiates our firm opinion that seat belts can reduce the severity of injury for vehicular occupants when impact occurs. There is a relationship between the severity of injury to collapse of structure of occupants area of the vehicle. As the severity of impact which causes structural collapse is increased, the value of seat belts recedes.

This statement in no way detracts from seat belt use, but in reality does much to promote such use, for the total accident analysis indicates the majority of accidents occur in the realm of lesser severity than fatal nonsurvivable impacts.

In our crash injury research studies in 1949 we began to notice a trend or pattern of increased survivability and reduced injury if a restraining device had been used by occupants under impact conditions in many accidents. As the research progressed this became more evident. Investigators were alerted to such conditions in order to increase knowledge and data on these actual highway impact conditions. Our analysis, although the volume was small, did locate and find a pattern which since has been substantiated by other research.

Many letters and bits of information reach this office relating experiences of vehicle occupants how seat belts reduced the severity of injury under impact condition. Their letters are not solicited but voluntary statements of individuals knowing our interest in this matter.

We now have 41 seat belt report cases, other than above, we believe to be true and valid cases. The volume again is small but the same repetitive pattern is evident. May we repeat with firm emphasis that our data continues to reveal that a seat belt can reduce the severity of injury as long as there is absence of vehicle body structure collapse.

The following information is in the nature of a summary report on the seat belt reports in our file.

41 accident cases—vehicle had seat belts installed.
33 cases when seat belts were fastened.
8 cases when seat belts were not used.
73 occupants involved in the above 41 cases.
10 occupants had no belt provided.
63 occupants had belts available for use.
48 occupants using seat belts.
15 seat belts were not in use at impact.
48 occupants using seat belts.
41 reported reduced injury from such use. Impacts covered the range from moderate to severe impact. Occupant and investigator agree in a number of cases a fatality was averted.
5 occupants with belts died in 3 different impacts—all collisions of extreme severity where structure failed and collapsed. These would definitely be classified as a nonsurvivable accident.
2 occupants with belts reported questionable benefit. Partial collapse of structure in this one survivable accident leaves some doubt if belts were of value to wearer.

ITEMS OF INTEREST

Padded instrument panel

Twenty-one cars had padded instrument panels. Twenty cars had no safety padded instrument panel.

There were nine cases of safety instrument panel where no head injuries were reported, but such sampling is too small to bring up this discussion. We do believe it noteworthy of the number of safety instrument panels in these sample cases.

Ejection

Two people wearing seat belts were ejected. One, a door-belt type installation, permitted occupant ejection for belts were not being worn tightly. The door came partly open and permitted ejection.

One person wearing a belt was ejected due to opening of buckle. Unable to determine if a buckle failure or a result of occupant motion.

We had no belt webbing failure or anchor failure in these reports. We did have a few improper installations but no negative results.

Three occupants without belts died in three separate survivable accidents. Forced ejection contributed to the fatal injury of these occupants.

COMMENTS

When studying and analyzing the summary data of these seat-belt reports one must concede that there is a definite margin of safety in favor of seat-belt use, however, it is much, more impressive when one reviews and analyzes each individual case.

These recent cases plus our experience over the years causes an opinion to be formed.

It causes one to speak with firm conviction for this information is from the real life-and-death expreiences of our highways.

May you and your committee be complimented in your endeavors. May you produce some media to bring about increased traffic safety.

If we may be of additional service to you or members of your committee, please advise.

Very truly yours,

HAROLD S. ZEIS, *Superintendent.*

Seat belt reports 1956

Case	Belts in use	Number of occupants in vehicle	Number of belts provided	Number of belts in use	Number of occupants not having belts	Number of occupants having but not using belts	Injured	Fatal	Structure	Occupants with belts ejected	Occupants without belts	Injury reduced	Non-survivable	Belt retarded front seat	Head injuries	Padded dash
1	Y	1	1	1	0	0	1	1-F	TC	0	0	N-1	Y	N	Y	Y
2	Y	3	2	2	1	0	3	0	PC	0	0	N-1 Y-2	0	Y	Y	Y
3	Y	1	1	1	0	0	1	0	PC	0	0	Y-1	0	(?)	N	Y
4	Y	2	2	2	0	1	2	0	TC	0	0	Y-2	0	(?)	Y	Y
5	Y	6	2	1	4	0	N-1 Y-5	0	PC	0	2	Y-1 N-5	0	(?)	N	Y
6	Y	1	1	1	0	0	1	0	PC	0	0	Y-1	0	Y	N	Y
7	Y	1	1	1	0	0	N-1	0	PC	0	0	Y-1	0	Y	N	Y
8	Y	1	1	1	0	0	1	0	S	0	0	Y-2	0	Y	N	Y
9	Y	2	2	2	0	0	N-2	0	S	0	0	Y-2	0	Y	N	Y
10	Y	2	2	2	0	0	N-2	0	PC	0	0	Y-1	0	Y	N	Y
11	Y	1	1	1	0	0	N-1	0	PC	0	0	Y-1	0	Y	N	Y
12	Y	1	1	1	0	0	N-1	0	PC	0	0	Y-1	0	Y	N	Y
13	Y	1	1	1	0	0	N-1	0	S	0	0	Y-1	0	Y	N	Y
14	N	2	2	0	1	1	Y-1	0	PC	0	1	N-1 Y-1	0	Y	N	Y
15	Y	3	2	2	1	0	Y-2	0	PC	0	0	N-1 Y-2	0	Y	N	Y
16	Y	1	1	1	0	0	N-1 Y-1	0	PC	0	0	N-1	0	Y	N	Y
17	Y	1	1	1	0	0	N-1	0	S	0	0	Y-1	0	Y	N	Y
18	Y	1	1	1	0	0	Y-1	0	PC	0	0	Y-1	0	Y	N	Y
19	Y	1	1	1	0	0	Y-1	0	PC	0	0	Y-1	0	Y	N	Y
20	Y	2	2	2	0	1	N-2	0	PC	0	1	N-1 ?-1	0	Y	N	Y
21	Y	2	2	2	0	0	Y-2	N	PC	0	0	Y-2	0	Y	N	Y
22	N	1	1	0	1	0	Y-1	N	(?)	0	0	N	0	Y	N	Y
23	Y	2	2	2	0	0	N-1 Y-1	N	RO	1	0	Y-2	N	Y	N	Y
24	Y	2	2	2	0	0	Y-2	N	S	0	0	N-2	0	Y	N	Y
25	N	2	2	2	0	2	N-1 Y-1	1-F	PC	0	2	Y-2	0	Y	N	Y
26	Y	2	2	2	0	0	Y-1	0	(?)	0	0	N-1	0	Y	N	Y
27	N	1	1	0	0	1	0	0		0	0		0	N	Y	Y

1957

1957

1	N	1	1	0	Y-1 N-1	N	PC	0	0	N Y-2	N	N	N	N	Y N-2
2	Y	1	2	2	Y-1 Y-1	N	PC	1	0	N Y-1	N	N	N	N	Y N
3	N	1	1	0	N-1 N-1	N	PC	0	0	Y-1 Y-2	N	N	N	N	N Y-1
4	Y	1	2	2	N-1 Y-2	N	TC	0	0	Y-1 N-3	N	N	N	N	Y N-0
5	N	1	2	2	N-1 Y-3	2-N	TC	0	0	Y-1 Q-2	N	N	N	N	N Y-3
6	Y	1	2	2	Y-4	2-F	TC	0	0	Q-2	N	N	N	N	Y Y-2
7	Y	1	2	2	Y-2	1-F	TC	0	0	N-2	N	N	N	N	N Y-1
8	Y	1	2	2	N-1	2-F	PC	0	0	Y-2	N	N	N	N	Y Y
9	Y	1	1	1	Y-1	N	PC	0	0	N	N	N	N	N	N Y
10	Y	1	1	2	Y-2	N	PC	1	0	N-1 Y-2	N	N	N	N	N Y
11	Y	1	2	2	N-2	N	PC	2	0	Y-2	N	N	N	N	N Y
12	Y	1	2	2	Y-1	N	PC	2	0	N-2	N	N	N	N	N Y
13	N	1	2	2	N-1	N	PC	0	0	Y-2	N	N	N	N	N Y
14	Y	1	2	1	Y-1	N	PC	0	(1)	Y-1	N	N	N	N	N Y

[1] Partly.

Indiana State Police
FORM SB-2

SUPPLEMENTARY REPORT

ISP Case No. _____

Did front seat adjustment track loosen _____ Did instrument panel have safety padding _____

Did belt retard forward motion of front seat _____ Did sun-visor have safety padding _____

If seat belts were anchored to floor:

Did anchors cause floor pan to { bend _____ How much _____ Inches
tear _____ How much _____ Inches

Was belt anchored with { plate _____ } size { Above floor _____ Inches
washer _____ } { Below floor _____ Inches

Were any two occupants under one belt _____

*If above answer is "yes," were there any unfavorable results _____

Occupant's Position	DRIVER	CENTER FRONT	RIGHT FRONT	LEFT REAR	CENTER REAR	RIGHT REAR
Did belt reduce severity of injury for						
Were injuries FATAL or SURVIVABLE (Mark F or S)						
Were any head injuries sustained by						
Was any soreness about hips or abdominal area by . . .						
Were any injuries increased by seat belt to						

This car was a _____
Year Make 2 or 4 Door Sedan Convertible

This report completed by _____

Organization _____

Address _____

Form CCIR AU–30

CUMC CASE NO. _____

A STUDY OF THE EFFECTIVENESS OF SEAT BELTS IN AUTO ACCIDENTS

Upon completion MAIL TO:

AUTO CRASH INJURY RESEARCH
Cornell University Medical College
1300 York Avenue, New York 21, N.Y.

Accident Date _____ Time _____ Location _____ State _____

SEAT BELT TYPE:

Lap ☐ Combination lap and shoulder harness ☐
Width of webbing ____ inches

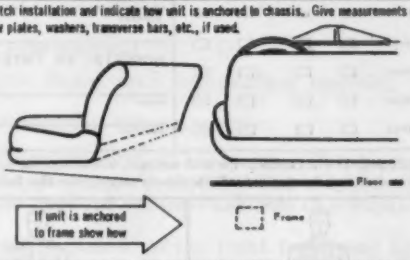
TRADE NAME OR MANUFACTURER OF:

Belt: _____
Buckle (if not the same) _____

SPECIFICATIONS of belt installation. Check where applicable.

Terminals attached to:	How attached:
☐ Floor pan	☐ Vertical bolt ____ in. thick
☐ Frame	☐ U-bolt _____ in. thick
☐ Door	☐ ____ inch cable and wire clamps
☐ Seat	☐ (other) _____

Sketch installation and indicate how unit is anchored to chassis. Give measurements of anchor plates, washers, transverse bars, etc., if used.



SEATED POSITION	PHYSICAL FACTORS				BELTS PROVIDED		BELT SECURED DURING COLLISION		INJURED	NOT INJURED	COMPLETELY EJECTED	NOT EJECTED	DEGREE OF BELT ADJUSTMENT TIGHT, SNUG (AVERAGE), LOOSE
	AGE	WGT	HGT	SEX	YES	NO	YES	NO					
DRIVER													
CENTER FRONT													
RIGHT FRONT													
LEFT REAR													
CENTER REAR													
RIGHT REAR													

SEAT BELT PERFORMANCE: (If webbing, buckle, attachment fittings, etc., failed in any way, please give specific information, i.e. location and extent of webbing failure, defective buckle component, etc.)

DESCRIPTION AND SKETCH OF ACCIDENT (Sketch position of car(s) before, at, and after impact. Show object struck. Show rollover. If occupants were ejected from car show when and where. Indicate direction of principal impact on vehicle. If photographs taken please attach.

Remarks: _____

COLLISION

SUBJECT CAR → { STRUCK / WAS STRUCK BY } → { MOVING / STATIONARY } → { VEHICLE / OBJECT }

If car struck object, describe: (stone abutment; tree 16 in. diam.); fence (log). If object was moved by impact, state extent.

ROLLOVER

- ☐ ROLLOVER BEFORE COLLISION
- ☐ ROLLOVER AFTER COLLISION
- ☐ ROLLOVER WITHOUT COLLISION
- ___ AMOUNT (¼, ½, ¾, 1, 3, UNK., ETC.)

ESTIMATED SPEEDS

	PRIOR TO ACCIDENT	AT IMPACT
SUBJECT CAR		
PRINCIPAL OTHER VEHICLE		

SPECIFICATIONS

MAKE OF CAR	YEAR	BODY STYLE (2 DOOR SEDAN, 4 DOOR SEDAN, ETC.)

DOORS OPENED

	FORCED OPEN IN ACCIDENT		DOOR SAFETY LATCH ENGAGED	
	YES	NO	YES	NO
LT. FRONT	☐	☐	☐	☐
RT. FRONT	☐	☐	☐	☐
LT. REAR	☐	☐	☐	☐
RT. REAR	☐	☐	☐	☐

DRIVER

NAME

ADDRESS

HOSPITAL OR PHYSICIAN*

NAME

ADDRESS

INJURIES AND THEIR CAUSES. For each occupant, briefly describe injuries; use arrows to show their location and indicate objects causing them (See Sample)

DRIVER

CENTER FRONT SEAT

RIGHT FRONT SEAT

LEFT REAR SEAT

CENTER REAR SEAT

RIGHT REAR SEAT

*If available, please attach medical report by attending physician

This form developed by Automotive Crash Injury Research, Cornell University Medical College, New York 21, New York.

THE INDIANA STATE POLICE

Auto crash injury research—annual report, released October 1, 1954—third edition, 1957—Harold S. Zeis, superintendent

AUTO CRASH INJURY RESEARCH, 1952

This report presents, in totals, a set of facts in statistical form, on the characteristics of 495 Indiana rural fatal motor-vehicle traffic accidents.

These data are based upon information from investigations at the scene, by State police personnel throughout the State during 1952.

Materials presented herewith were prepared under the supervision of Sgt. Elmer Paul, with authority from the superintendent.

The purpose of the study was to determine if possible, which factors of or in the vehicle contributed to the cause of serious injury or death, which if removed, improved or supplemented could prevent such extent of injury.

The study, as indicated by the following facts, identifies the basic problem of saving lives in highway collisions as holding your seat in the crash. Doing this greatly increases your chance for survival. Motion of a vehicle is suddenly arrested in a crash, but occupants continue in motion. When the occupants motion is suddenly arrested, the objects that stop such motion inflict various degrees of injury.

This report comprises information secured from rural fatal traffic accident cases which were applicable to the auto crash injury research study. All information from the following:

495 rural fatal traffic accident cases.
616 fatalities.
850 total number of cars involved.
1,858 total number of occupants in all cars involved.

All data factual but not conclusive, based upon information received.

OCCUPANTS SEATED POSITION VERSUS INJURY

The following data shows the relationship between occupants and injury, also the driver occupant in contrast to the passenger occupant. The relationship in the different comparisions indicate the need for detailed analysis of occupants in the front seat of the vehicle.

At the present time much emphasis is placed on the right front seat as the most dangerous seat. This is correct for passenger occupants for several reasons. However, more consideration must be given to the driver occupant if data will continue to reveal approximately 50 percent of vehicular occupant fatalities are drivers.

Occupants in all cars involved	1,858
85 percent of total occupants received injury	1,583
52 percent of total occupants received survivable injury	967
33 percent of total occupants received fatal injury	616
15 percent of total occupants received no physical injury	275
Occupant fatalities, 616 total:	
49.6 percent of fatilities were driver occupants	306
50.4 percent of fatalities were passenger occupants	310

However, 143 (47 percent of the 306 drivers were alone in the car at collision. Therefore, for comparative occupant injury exposure study, we consider in a separate category:

34 percent driver fatalies—with other occupants	163
66 percent passenger fatilities	310
Passenger occupant fatalities:	
75 percent in right front seat area	233
25 percent in rear seat area	77
Fatal occupants seated position:	
Driver fatalities when alone in the car	143
Driver fatalities with other occupants in the car	163
In center front seat	41
In right front seat	192
In left rear seat	24
In center rear seat	16
In right rear seat	37

97108 O—57——16

FATAL INJURIES

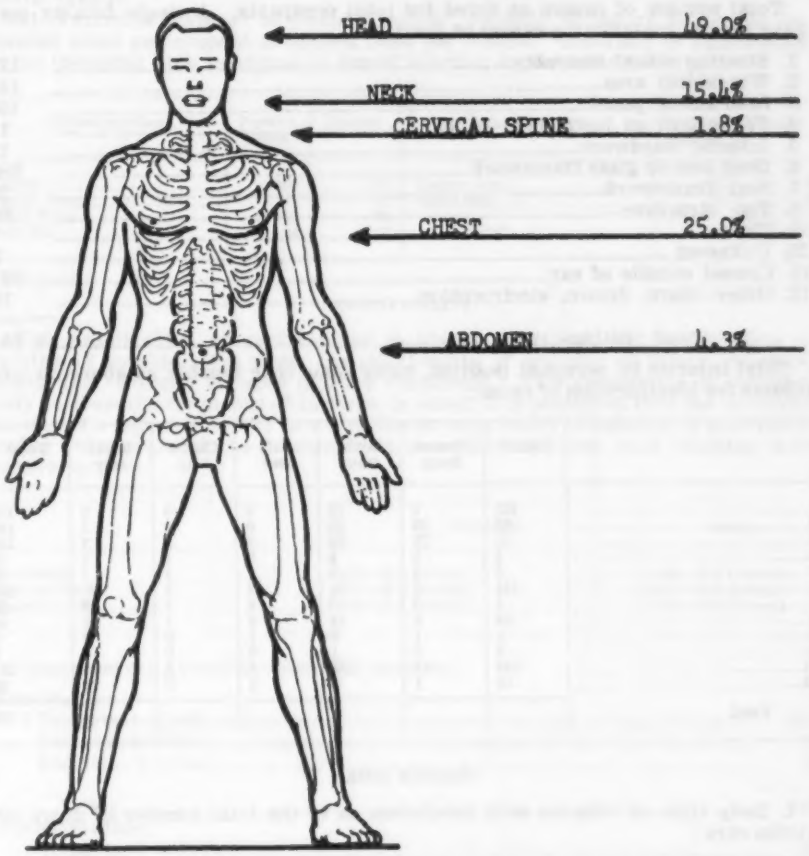
Relative frequency of listed injury to body area for 616 fatalities.

Body area:	*Number*
1. Head	430
2. Neck	135
3. Cervical spine	16
4. Chest	220
5. Dorsal spine	2
6. Back	8
7. Abdomen	38
8. Lumbar spine	1
9. Pelvis	4
10. Dismembered	4
11. Multiple fracture	2
12. Complications, shock, other—etc	18
Total number of listed injuries	878

Frequency of injury for various occupants position in vehicle at time of impact (column at left is identification for area of body as above):

	Driver	Center front	Right front	Left rear	Center rear	Right rear	Total
1	208	24	140	16	12	30	430
2	74	5	42	5	3	6	135
3	4	0	9	0	2	1	16
4	134	8	56	4	5	13	220
5	0	0	1	0	1	0	2
6	4	0	1	1	2	0	8
7	19	4	14	1	0	0	38
8	0	0	0	0	1	0	1
9	3	0	1	0	0	0	4
10	4	0	0	0	0	0	4
11	0	0	1	0	0	1	2
12	8	3	4	2	0	1	18
Total							878

PREDOMINATE FATAL INJURIES



The high incidence of fatal head and chest injury, compared to lower frequency of other fatal injuries should cause concern to alleviate such conditions. Any change, human or mechanical, to reduce the severity of injury when in collision would be a major achievement in traffic accident safety.

CAUSES OF FATAL INJURY

Total number of causes as listed for total occupants. A single fatality may have several contributing causes of death:

1. Steering wheel assembly	171
2. Windshield area	146
3. Instrument panel	154
4. Projections on instrument panel	11
5. Interior hardware	12
6. Door and/or glass framework	280
7. Seat framework	23
8. Top structure	98
9. Floor	7
10. Unknown	3
11. Caused outside of car	261
12. Other—burn, drown, electrocution	18
Total listings	1,184

Total injuries by occupant position, using same code number as above on left column for identification of cause:

	Driver	Center front	Right front	Left rear	Center rear	Right rear	Total
1	161	0	10	0	0	0	171
2	66	16	63	0	0	1	146
3	47	21	82	0	3	1	154
4	4	1	4	0	1	1	11
5	6	1	2	1	1	1	12
6	144	6	91	12	6	21	280
7	5	0	0	4	5	9	23
8	49	8	18	8	4	11	98
9	1	1	2	1	0	2	7
10	2	0	1	0	0	0	3
11	143	11	85	5	3	14	261
12	11	1	2	3	0	1	18
Total							1,184

VEHICLE DOORS

I. Body style of vehicles with tabulation as to the total number of doors on victim cars:

Body style	Collisions (cars)	Number of doors
4-door sedan	201	804
2-door sedan	215	430
2-door coupe	46	92
2-door convertible (cloth-top)	22	44
2-door convertible (hard-top)	4	8
2-door station wagon	6	12
2-door hot rod	1	2
Total	495	1,392

II. Number of impacts in which doors opened:

	Impacts
1 door opened or 161 doors	161
2 doors opened or 370 doors	185
3 doors opened or 57 doors	19
4 doors opened or 176 doors	44
No doors opened or 0 doors	71
Unknown	15

In 495 impacts a total of 764 doors or 54.8 percent of the doors came open on the victim vehicle.

III. Fatalities involved in forced ejection: Severity of injury is usually increased when an occupant is thrown from the vehicle. Certainly of significance is the indicated high incidence of forced ejection in the table below.

Seated position	Persons killed	Ejected	Seated position	Persons killed	Ejected
Driver	306	154	Center rear	16	4
Center front	41	21	Right rear	37	13
Right front	192	90			
Left rear	24	8	Total	616	[1] 290

[1] 47 percent.

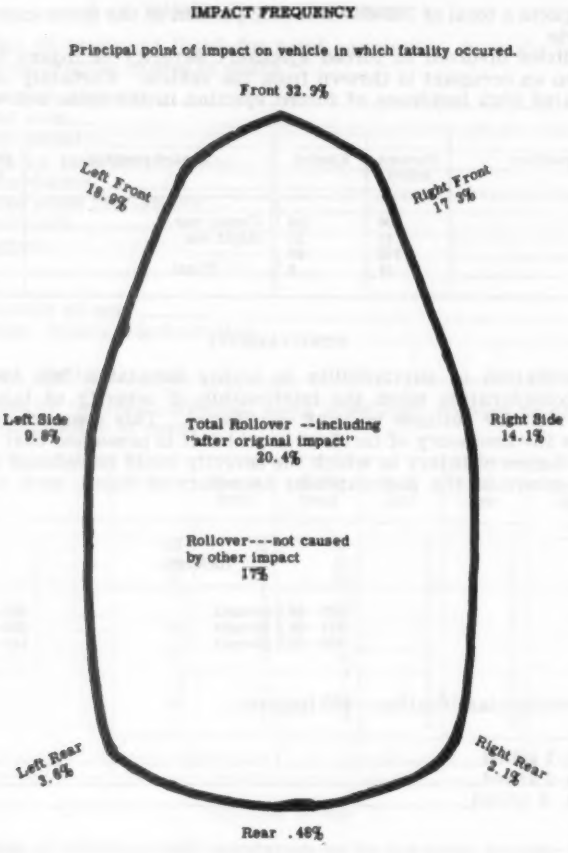
SURVIVABILITY

The classification of survivability is highly debatable, but nevertheless is worthy of consideration when the relationship of severity of injury, cause of death and vehicular collapse is being considered. This comparison is intended only to show the frequency of incident in which it is presumed that the occupant sustained a degree of injury in which the severity could be reduced or alleviated. Being duly aware of the presumptions necessary at times, such thinking does border fact.

	Incidents	Deaths
Survivable	245—49.5 percent	268—43.5 percent.
Nonsurvivable	141—28.5 percent	204—33.1 percent.
Questionable	109—22.0 percent	144—23.3 percent.

Impact severity classification—495 impacts:

Survivable:	
Impacts, 1 killed	224
Impacts, 2 killed	19
Impacts, 3 killed	2
Total	245
Nonsurvivable:	
Impacts, 1 killed	97
Impacts, 2 killed	30
Impacts, 3 killed	9
Impacts, 4 killed	5
Total	141
Questionable:	
Impacts, 1 killed	83
Impacts, 2 killed	18
Impacts, 3 killed	7
Impacts, 4 killed	1
Total	109



GENERAL INFORMATION

Steering wheels

The following listings may include multiple listings of damage to 495 vehicles:

Cases of steering wheel remaining intact	181
Cases of steering wheel rim breaking	55
Cases of steering wheel rim bending	217
Cases of steering wheel spokes bending	83
Cases of steering wheel spokes breaking at rim	20
Cases of steering wheel spokes breaking at hub	64

Steering column

These notations are only on movement of the steering column inside the 495 vehicles after impact:

Cases of "other than original position" (41.2 percent)	204
Cases of no movement of steering post (56.9 percent)	282
Cases not certain (1.8 percent)	9

Instrument panels

Multiple indications of damage after impact is included in these figures:

Listings—instrument panel remained intact	203
Listings—instrument panel dented by body contact	92
Listings—instrument panel structural deformation	273

Door condition after impact

Vehicular cases—doors would close as they should	24
Vehicular cases—doors would close to safety catch	20
Vehicular cases—doors would not close—no door damage	17
Vehicular cases—doors would close as damaged	386
Vehicular cases—unknown/not stated	48

Number of cars per accident in this study:	*Cases*
1-car accidents	180
2-car accidents	279
3-car accidents	32
4-car accidents	4

Total number of cars involved, 850.

Number of persons killed per accident:	*Cases*
1 killed per accident	404
2 killed per accident	67
3 killed per accident	18
4 killed per accident	6

Total number killed, 616.

Drivers' exposure:	
Impacts—drivers were killed when alone in the car	143
Impacts—drivers were killed but no other occupants were killed	93
Impacts—drivers were killed when other occupant fatality occurred	70
Impacts—no driver was killed when occupant fatality occurred	189

Forced ejection:

Of 1,858 occupants in all the 850 cars involved in fatal accidents, 626 occupants (33.7 percent) were thrown from the vehicle.

Of 1,276 occupants in the 495 cars in which the fatality occurred, a total of 517 occupants (40.5 percent) were thrown from the vehicle.

Of 517 occupants thrown from the fatal cars, 290 (56 percent) occupants were among the 616 fatalities.

Of 616 occupants killed, the incident of forced ejection was recorded in 290 (47 percent) of the cases.

Vehicles by make and year—Year 1952

	Total	Car A	Car B	Car C	Car D	Car E	Car F	Car G	Car H	Car I	Car J	Car K	Car L	Car M	Car N	Car O	Car P	Car Q	Car R	Car S	Car T	Car U
Total	495	29	7	106	26	23	14	8	21	62	101	2	12	2	6	4	17	17	7	20	8	3
1952	31	2	0	8	3	2		2	1	3	4		0		0		2	1	1	1	1	
1951	81	6	2	10	3	4	2		2	8	20	1	2		4	1	4	5	2	3	2	
1950	98	8	5	17	5	6	1		4	10	19	1	3		2		2	6	1	6	1	1
1949	64	3		8	5	1	4	1	3	5	19		4	1		1	5		1	2	1	
1948	36	1		4	1	2	4		4	4	3		0	1		1	3	3	1	3		1
1947	35	1		14		3			3	7	1		3			1				1		1
1946	28	3		8	1		1	2		3	8							1		1		
1942	8							2		2	2											
1941	36	3		11	2	2	1	1	2	4	8							1		1		
1940	24	1		8	2	1	1		1	3	5											
1939	14			6	1	2			1	0	4											
1938	6			3						3	0										2	
1937	19	1		3	2					7	3						1					
1936	7			2						1	3								1			
1935	3									2											1	
1934	2			2																		
1933	0										1											
1932	1																					
1931											1											
1929	1																					
1928	1			1																		

INDIANA STATE BOARD OF HEALTH,
August 14, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR MR. ROBERTS: Several months ago we did install seat belts in State-owned automobiles assigned to our department. This action was taken after the study of a few accidents involving our personnel, and a review of thorough studies done by the Indiana State Police Department and Cornell University.

Since the installation of the safety belts none of the State automobiles have been involved in accidents. Consequently, we have not had a chance to evaluate their effectiveness firsthand; however, we are convinced of their value and intend to keep them.

Sincerely,

A. C. OFFUTT, M. D.,
State Health Commissioner.

THE KANSAS STATE BOARD OF HEALTH,
Topeka, Kans., July 25, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: We were pleased to receive your letter of July 19, requesting information about the use of automobile seat belts by members of this department.

The Kansas State Board of Health has no firm policy regarding the purchase of seat belts in all of its State-owned vehicles. We recognize their value and encourage their use by all employees. If the individual to whom a State-owned car is to be assigned requests that it be equipped with seat belts, the car is ordered with this equipment. At the present time, of the 40 State-owned cars operated by this department, 10 are equipped with seat belts.

We have not undertaken any studies here to determine the protective value of seat belts but are convinced of their effectiveness as evidenced by the flow of scientific data from Cornell and other universities, automobile manufacturers, and the Armed Forces.

We will appreciate seeing a copy of the hearings of the Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce when it is printed.

Sincerely yours,

THOMAS R. HOOP, M. D., M. P. H.,
Executive Secretary.

THE COMMONWEALTH OF MASSACHUSETTS,
DEPARTMENT OF PUBLIC SAFETY,
Boston, Mass., August 2, 1957.

Hon. KENNETH A. ROBERTS,
House of Representatives, Washington, D. C.

DEAR SIR: This department will be very pleased to assist the Special Subcommittee of Traffic Safety of the House Interstate and Foreign Commerce Committee in any way possible.

Seat belts were first installed in State police cars in January of 1956 and in several instances they have very definitely prevented serious injury. There have been 6 accidents involving our cars where the speeds were between 40 and 70 miles per hour, and the troopers had the belts fastened. No injuries were sustained in any of these instances except where one officer suffered very minor bruises.

It is the opinion of the ranking officers in the State police that seat belts are an effective means of reducing injury in case of accident, and we are certainly going to continue using them. We also feel that considerable savings to the Commonwealth can ensue in the way of medical expenses which might occur if the trooper were seriously injured while on duty.

I trust the above will be of assistance to you in your report and please do not hesitate to call upon us if we can be of any further help.

Very truly yours,

CLAYTON L. HAVEY,
Acting Commissioner of Public Safety.

MICHIGAN STATE POLICE,
East Lansing, August 6, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Safety, Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: Your letter of July 19 requesting information concerning the use of automobile safety belts in motor vehicles operated by this department has been referred to me for attention.

This department has ordered safety belts as regular equipment in all replacement patrol cars since January 1956. At the present time about 240 out of 359 regular patrol cars are now equipped with safety belts.

It is intended that the policy be continued, that all new patrol cars put in service be equipped with safety belts, and that after all regular patrol cars are so equipped that the same policy will apply to replacement vehicles used by detectives and administrative personnel.

This department has found safety belts to be satisfactory; however, the small number of accidents in which our departmental cars have been involved will not permit the calculation of reliable facts as to ability of the safety belts to prevent injury.

Your subcommittee is referred to the annual reports on automotive crash injury research, published by the department of public health and preventive medicine, Cornell University Medical College, 1300 York Avenue, New York 21, N. Y., which contain information from the most extensive research conducted in this country on crash injury prevention.

I will appreciate very much receiving a copy of the report of your subcommittee on their findings concerning automobile safety belts.

Very truly yours,

SHIRLEY G. CURTIS,
Captain, Commanding Officer, Safety and Traffic Bureau.

STATE OF MINNESOTA,
DEPARTMENT OF HIGHWAYS,
St. Paul, July 30, 1957.

Re automobile seat belts.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety, United States House of Representatives, Washington, D. C.

DEAR SIR: The Minnesota highway patrol has installed seat belts in all patrol units since January 1956. Since the original installation of belts in the units being used, the specifications for the purchase of all units have included safety belts. At present we have 285 units in service. The supervisors' cars have 2 belts and the officers' units have 1 belt, due to the fact that the supervisor oftentimes has a passenger, while the patrol officers work on a 1-man-car basis.

Since the installation of these safety belts, we have had several serious accidents in which patrol units have rolled over. Invariably the officer involved has stated that had it not been for the fact that the safety belt was used, the accident would have resulted in either serious injury or a fatality to our officer.

When the safety belts were first installed, the officers made little use of them because of the necessity of getting in and out of their units constantly. However, since the occurrence of a series of accidents which proved the great value of the belt, this obstacle has been overcome.

With the successful use of safety belts by the highway patrol, Governor Freeman requested that they be installed in all State-owned vehicles.

If we can be of further service to you, please feel free to contact us.

Yours very truly,

PAUL R. MARTZ,
Chief, Minnesota Highway Patrol.
By LEO M. SMITH,
Assistant Chief.

STATE OF MINNESOTA,
DEPARTMENT OF HEALTH,
Minneapolis, July 31, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

MY DEAR MR. ROBERTS: In reply to your letter of July 20, 1957, regarding automobile safety belts I am very glad to have the opportunity to make a statement.

Since August 1, 1956, the Minnesota highway patrol and the Minnesota Department of Health in cooperation with the Minnesota State Medical Association and the Minnesota Hospital Association have participated in the Cornell automotive crash injury research. Previously, the Minneapolis Health Department had participated in a citywide study with the Cornell group. Serving as medical coordinator, we have had the opportunity of reviewing the highway patrol's reports of accidents and their photographs of the damaged cars as well as the medical reports of injuries submitted by attending physicians. We have been impressed with severity of the injuries or fatal outcome of the occupants who were thrown out of the automobile in contrast to the less serious injuries of those who remained in the car involved in an accident.

Because of these findings, the Minnesota Department of Health and the Minnesota Highway Department have installed safety belts in their State-owned vehicles. A copy of the memorandum to the State department of administration clearly indicates our attitude as to the desirability of safety belts.

In recent months there have been a number of occasions when officers, unavoidably, were involved in situations where their patrol cars were rolled over. They all report that the proper use of safety belts in their cars saved them from serious injury. As a result, Governor Freeman, who has been very active in the field of accident prevention, has recommended that all State department heads see to it that all units under their control be equipped with approved safety belts and that operators be instructed to use them whenever driving a State unit. A copy of the Governor's memorandum is also enclosed.

Our impressions as to the value of safety belts gained from the Minnesota crash injury study have been amply confirmed by the analyses of matched accidents of automobiles with and without such belts by the Cornell automotive crash injury research. We are convinced safety belts should be used in cars as a means of reducing serious injuries and fatalities and that such utilization will demonstrate their value in the field of safety.

Respectfully,

R. N. BARR, M. D.,
Secretary and Executive Officer.

DECEMEBR 6, 1956.

To: Mr. Arthur Naftalin, Commissioner of Administration.
From: Dr. R. N. Barr, Secretary and Executive Officer.
Subject: Safety Equipment on State Motor Vehicles.

The State of Minnesota is cooperating with the Cornell automotive crash injury research in determining what are the safety features relative to construction of motor vehicles that will reduce injuries and deaths of the occupants of such vehicles. As you know, the highway department collects information on the accidents and the health department collects information on the injuries to the occupants of such vehicles, combining the two together and forwarding the data to the Cornell automotive crash injury research.

Minneapolis, the first city in the country to enter in this study, has completed its information for the first 18 months. The State will be in such a study for the next 2 years, or longer, and some 11 other States are cooperating in the same manner.

On Monday, December 3, 1956, Dr. John O. Moore, director of the study, along with Mr. Robert M. Tracy, his associate, reported on the material they have collected to date, which included the various safety features now incorporated in a considerable portion of the motor vehicles being produced. These reports indicated a marked reduction in the severity of injuries, deaths, and number of injuries of occupants in cars equipped with these safety devices which included: Safety locks on the doors; safety belts; recessed steering posts, and protective safety padding on the dash and on the sun visor.

It would appear that the State should take some leadership in providing cars for the use of its personnel with all of these safety devices and it is,

therefore, suggested that such devices should be included in the specifications for all cars to be purchased by the State.

The highway department and health department have incorporated safety belts on all automobiles owned and operated by these departments. It is very possible that other departments have done the same, but it would appear that if not some way of securing their cooperation for the inclusion and use of safety belts should be developed at the State level.

As you know, Governor Freeman is very interested in this study and this safety program and has given it his wholehearted support.

JULY 23, 1957.

To All Department Heads:

Our State departments had an outstanding reduction in accident frequency rates in 1956 which were 31.6 percent lower than that of 1955. In 1956, we had only 9.3 lost time accidents per million man-hours, whereas in 1955 our rate was 13.6. This was accomplished through the united efforts of our employees who are becoming more safety conscious and are following safe practices in their work.

However, there is one field in which our State employees should always take the lead, and that is in the field of traffic safety. We have had employees injured and killed on the job in collisions which, unfortunately, do happen. Officers of the Minnesota highway patrol form one group which is exposed to possible accident while on duty. In recent months, there have been a number of occasions when officers, unavoidably, were involved in situations where their patrol cars were rolled over. They all report that the one thing that saved them from serious injury was the fact that their cars were equipped with safety belts, and further, these belts were used properly. Other large fleet operators report the same results—that safety belts are lowering the number of injuries resulting from traffic accidents, lowering the number of lost man-hours, saving the employers money in addition to preventing tragedy from ruining the homes of their employees.

Therefore, based on our experience with some of the State units and following the advice of expert safety researchers, I am recommending that all State units be made as safe as possible for their operators. It will be your responsibility, as the head of your department, to see that all units under your control will be equipped with approved type safety belts, and that the operators be instructed to use them whenever driving a State unit.

Sincerely,

ORVILLE L. FREEMAN, *Governor.*

MISSOURI STATE HIGHWAY PATROL,
Jefferson City, July 26, 1957.

Hon. KENNETH A. ROBERTS,
Special Subcommittee on Traffic Safety, Congress of the United States, House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: All of the motor equipment operated by this department has been equipped with safety belts since January of 1956, and we are very well pleased with our experience in the use of these belts.

In October of 1955 one of our officers was fatally injured in a traffic accident. His death was caused by being hurled to the pavement after the original impact. We are firmly convinced that had this officer being using a seat belt, he would not have been thrown from his vehicle and in all probability would not have been seriously injured.

This accident greatly influenced our decision to equip all of our vehicles with safety belts. Our officers are instructed to use the belts at all times when operating patrol equipment. Since we have equipped our vehicles with safety belts, we have had a number of officers involved in serious accidents, but none of our men have received major injuries. Several of our officers who have been involved in accidents credit the use of the safety belts for saving their lives.

Our experience with the use of these belts has been entirely satisfactory and we plan to continue equipping our vehicles with them. You have my permission to use the information in this letter in any manner in which you desire.

Yours very truly,

HUGH H. WAGGONER, *Superintendent.*

The DIVISION OF HEALTH OF MISSOURI,
Jefferson City, Mo., July 23, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR REPRESENTATIVE ROBERTS: In reply to your letter ofJuly 20 I am pleased to furnish the following information regarding the experience of the Division of Health of Missouri in the use of automobile safety belts.

During 1956, at the recommendation of the Missouri highway patrol, employees using division of health vehicles were urged to have safety belts installed in the front seat for the driver and one passenger. All vehicles purchased within the past 6 months have had safety belts installed as original equipment. Consequently, almost all of the division of health vehicles are now equipped with safety belts.

There is, of course, no way of determining if the belts are being used by the employees while operating the vehicle. I am inclined to believe that because of a number of favorable comments by the employees and also because of the absence of any criticism the belts are being used for highway driving. We, therefore, expect to keep the safety belts and will continue to install them in the vehicles purchased in the future.

As there have been no accidents involving division of health vehicles since the installation of safety belts, our experience can contribute little to the committee's study of the crash worthiness of automobile safety belts.

I shall look forward to receiving a copy of the hearings and learning of the experience of other agencies and organizations in the use of automobile safety belts.

Respectfully yours,

H. M. HARDWICKE, M. D.,
Acting Director.

NEVADA DEPARTMENT OF MOTOR VEHICLES,
NEVADA HIGHWAY PATROL DIVISION,
Carson City, Nev., July 30, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety,
House Office Building, Washington, D. C.

DEAR SIR: Reference is made to your correspondence regarding the installation and use of automobile safety belts in Nevada highway-patrol vehicles.

The Nevada highway patrol has had safety belts installed in all vehicles used by the patrol since 1953. Since that time the automobile manufacturers have incorporated padded sun visors, dash panels, and depressed steering wheels, all safety features, as recommended by the automotive crash-injury research, Cornell University Medical College, in New York City.

Our vehicle specifications for fleet purchases definitely stipulate that these added safety features must be included in the vehicle manufacturing process prior to delivery to the patrol.

The rules and regulations of our department specifically spell out that the personnel must use the safety belt at all times whenever the patrol vehicle is in motion. Violation of this regulation is cause for disciplinary action.

From our experiences in automobile accident investigation, our officers have reported that many fatality and injury accident victims could have been avoided if they had had safety belts installed in their vehicles and if they were in use at the time of their mishap.

Usually, the victim of a fatality accident, especially single car, high-speed accidents, is the result of the victim being ejected out of the vehicle, and killed on impact with an object or the ground; or he is ejected part way out of the vehicle and the vehicle rolls over him. These types of fatality accidents would be eliminated if the vehicle had safety belts, and they were in use at the time of the accident. Many serious accidents would also be eliminated if the vehicles were installed with safety belts and they were in use at the time of an accident.

We realize, of course, that there is the argument which states that if a person is tied in with a safety belt, and he is involved in a serious accident, there is no way for him to go out or away—he is actually tied there and must receive

the full impact of that accident. Experience has taught us these two things in accidents of this type:

1. Usually the victims are injured to varying degrees, but the fact remains that they are alive.

2. In the most serious accidents, such as high-speed, head-on collisions where impact speed exceeds 100 miles per hour or better, nothing would save the victims with or without safety belts installed in the vehicle.

We of the Nevada highway patrol are cooperating with Cornell University Medical College on all accidents involving automobiles with safety belts, and we forward all accident reports to that research center for their competent analysis.

We are very much in favor of the installation of safety belts in all vehicles. It is very disturbing to arrive at the scene of any accident and see the carnage that could have been averted had the use of safety belts been in effect at the time of the impact.

Respectfully yours,

ROBERT J. CLARK, *Director.*

NEVADA STATE DEPARTMENT OF HEALTH,
Carson City, Nev., July 24, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR MR. ROBERTS: As stated in your letter of July 20, 1957, this department does have seat belts on many of the State-owned automobiles. Luckily, no car equipped with belts has been involved in a serious accident. It is planned to purchase an automobile this fall for my official use. I intend to have it equipped with seat belts.

I shall be very happy to receive a copy of the report of your committee's hearings.

Sincerely,

DANIEL J. HURLEY, M. D.,
Acting State Health Officer.

NEW MEXICO STATE POLICE,
Santa Fe, N. Mex., August 1, 1957.

Hon. KENNETH A. ROBERTS,
Chairman of Subcommittee on Traffic Safety,
House Office Building, Washington, D. C.

DEAR MR. ROBERTS: In spot checking our officers, in their mobile units, we find that even though it is a regulation to use the seat belts, and the officers themselves recommend their use, they do not personally use them consistently. This is a shortcoming but it is a fact. We find this to be true in so many instances where a vehicle is equipped with seat belts yet the operators or occupants will not use them.

On the other hand, sir, we are attaching a copy of one of our recent radio items that specifically points out the fact that by wearing seat belts the vehicle No. 3 in a 3-car collision did save the occupants from serious injuries and possibly death. By wearing the seat belts the man and his wife were kept in place and formed a barrier for their youngsters who were asleep in the rear of the station wagon and thrown forward by the impact.

We sincerely hope this information might be of some value to your committee.

Very truly yours,

J. P. ROACH,
Chief, New Mexico State Police.

NEW MEXICO STATE POLICE

From: Captain Scroggins (public service).
Date: July 13, 1957.
Caption: Fatal accident:
Referred to: Chief, Albuquerque, front desk.

Details: Occurred 3:15 p. m., 19½ miles west of Gallup on U. S. 66, one-half mile east of New Mexico-Arizona State line. Involved three vehicles. No. 1

Pontiac going west. Driver and victim Edward W. Rippey, age 46, of 399 Sunset Trail, Nevada City, Calif. Passenger and victim Pauline Rippey, age 34, wife of driver. Passenger and victim Albert Rippey, age 4, same address. Passenger and injured, Gene Zunino, age 48, same address, in critical condition. All Army personnel. Vehicle No. 2: 1955 Mercury going east. Driver and victim Michael Keith Cochran, age 16, of 1065 Laguna Street, Anaheim, Calif. Passenger and victim Gladys Cochran, age 27; passenger and injured: Carl Cochran, age 28, in critical condition. Vehicle No. 3: Ford station wagon: driver Floyd Erwin Turner, 28, of 19619 Mart Street, Roseda, Calif., and passengers Margaret E. Turner, 27, Floyd Turner, Jr., 4, Gwyneth Turner, 2½, all uninjured. Mr. and Mrs. Turner had seat belts on, which saved them and the children.

Cause—No. 1: Skidded on wet road into path of No. 2. No. 3 following No. 2. Excessive speed for road conditions. Checked by Mahoney and Scroggins. (Five killed.)

NORTH CAROLINA DEPARTMENT OF MOTOR VEHICLES,
STATE HIGHWAY PATROL,
Raleigh, August 1, 1957.

Re: Automobile safety seat belts.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety
of the Committee on Interstate and Foreign Commerce,
House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: In reply to your letter of July 20, 1957, concerning the above-captioned subject, I want to thank you for your interest, and that of the committee, on the very important subject of the use and effectiveness of safety, seat belts in motor vehicles.

I am attaching herewith a copy of the North Carolina State Highway Patrol's General Order No. 36, dated May 4, 1956, which is self-explanatory and also reflects the very high opinion in which this safety equipment is held as to its value and effectiveness. The entire fleet of 600 State highway patrol cars are equipped with safety seat belts, and we would not consider abandoning their use.

This general order is the result of several years cooperative study and research between this department and the Division of Automotive Crash Injury Research of the Department of Public Health and Preventive Medicine, Cornell University Medical College, 1300 York Avenue, New York 21, N. Y., of which John O. Moore is director. North Carolina is one of the original participating States which is cooperating with Mr. Moore in this research project.

Also attached is a copy of the approval order, dated June 10, 1957, from Mr. Edward Scheidt, commissioner, North Carolina Department of Motor Vehicles, and the minimum qualifying standards to which his order refers. A marked copy of the summary of 1957 legislation and changes in the North Carolina motor vehicle laws enacted by our 1957 session of the general assembly which contains the legislation enacted on automobile safetyt seat belts also are included.

If I can be of further service in this matter, I would appreciate your advising me.

Sincerely,

JAMES R. SMITH,
Colonel, Commanding, State Highway Patrol.

NORTH CAROLINA STATE BOARD OF HEALTH,
Raleigh, July 23, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety,
House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: This is in reply to your inquiry of July 20 relative to our experience with the use of safety seat belts on automobiles owned and operated by the North Carolina State Board of Health.

Approximately 12 months ago the State board of health authorized and requested the installation of safety devices on all cars purchased for use by this department. The safety devices installed on cars recently purchased and cars

to be purchased in the future are: Safety belts, cushioned dashboards, safety steering wheels, backup lights, windshield washers, and safety lock doors. To date, we have had no serious accidents in which our cars with the above-mentioned safety devices have been involved. We cannot, therefore, report on the effectiveness of safety belts, but we are of the opinion, based on reports of accidents processed through this department for our State department of motor vehicles under the nationwide crash accident program, that the extra cost involved in equipping our cars with safety devices is well justified.

I have read with much interest the testimony of members of the Cornell committee for transportation safety research, as presented in hearings before the House committee on April 30, 1957. This testimony, together with periodic reports that we receive from time to time from the Cornell automotive crash injury research program, has convinced us that the use of safety belts and other automobile safety appliances is a most worthwhile procedure in the public interest.

Very truly yours,

J. W. R. NORTON, M. D.,
Secretary and State Health Officer.

SOUTH DAKOTA STATE DEPARTMENT OF HEALTH,
Pierre, July 24, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington, D. C.

DEAR MR. ROBERTS: Reference is made to your letter of July 20 regarding the use of seat belts in vehicles operated by the South Dakota State Department of Health.

We have been fortunate in not having had an accident which would have served as a test of the seat belts since they were adopted as standard equipment 2 years ago. The belts may have been a factor in the establishing of this record since they serve as a constant reminder to the driver of the dangers inherent in operating a motor vehicle on the highways. We plan to continue the use of seat belts in the future.

You may incorporate this report in the official record of your subcommittee if you wish to do so.

Very truly yours,

G. J. VAN HEUVELEN, M. D.,
State Health Officer.

TEXAS DEPARTMENT OF PUBLIC SAFETY,
Austin, July 24, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety, Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D. C.

DEAR SIR: This department began using seat belts as standard equipment on vehicles used in high-speed pursuit when we purchased our 1956 model fleet. Since that time, all vehicles purchased for such work have been so equipped. At this time we are operating some 250 belt-equipped vehicles.

We have had several instances where our men have been involved in serious accidents while driving belt-equipped cars at terrific speeds. In each case the injury sustained was definitely reduced by the use of safety belts. In most instances the injuries suffered were relatively minor considering the circumstances surrounding the accident.

The feeling of our personnel regarding seat belts is such that some of our men have purchased the belts with their own funds before we could make arrangements to equip the older model vehicles. In addition, men who operate the belt-equipped vehicles are beginning to purchase the belts for their own personal cars.

Our experience has been that the best selling point for the use of seat belts in our cars is the report of the man who has been involved in an accident while driving a belt-equipped patrol car.

This department is cooperating with Cornell University in its study of the effectiveness of seat belts. We make reports to them of all accidents involving belt-equipped vehicles.

Our injury experience in accidents involving belt-equipped cars is so favorable that we expect to continue the use of seat belts until some better device is made available.

Very truly yours,

HOMER GARRISON,
Director.
By W. J. ELLIOTT,
Chief, Texas Highway Patrol.

UTAH DEPARTMENT OF PUBLIC SAFETY,
UTAH HIGHWAY PATROL,
Salt Lake City, Utah, July 26, 1957.

Hon. KENNETH A. ROBERTS,
Chairman, Special Subcommittee on Traffic Safety,
House Office Building, Washington, D. C.

DEAR SIR: I am in receipt of your letter of July 20, 1957, regarding the use of safety belts in patrol cars of the Utah highway patrol.

Safety belts were installed in all of our patrol cars 2 years ago. Three of these cars have since been involved in serious accidents in which we feel that the use of these belts has either saved the officer's life or prevented serious injury.

In one instance, a head-on collision occurred between a patrol car and another vehicle resulting in extensive damage to the patrol car. The officer had his seat belt fastened and received only minor injuries to one finger and his knees.

On another occasion, a patrol car was forced into a concrete bridge resulting in very extensive damage to the car. The officer in this was only slightly bruised.

In the third instance, a patrol car traveling at approximately 90 miles per hour struck an animal on the roadway, completely demolishing the vehicle. The car skidded for several hundred feet but did not roll over. The officer attributed his ability to keep the car on its wheels to the fact that his seat belt kept him firmly in the seat and he did not lose his grip on the steering wheel.

From these experiences and others involving citizens who were using seat belts at the time they were involved in an accident, we are firmly convinced that lives can be saved and the seriousness of injuries materially reduced through the use of safety belts. It is a general order in this organization that safety belts be fastened any time the patrol car is in motion.

Trusting that the above information may be of some assistance to you in your investigations, I remain,

Very truly yours,

LYLE HYATT,
Superintendent, Utah Highway Patrol.

THE STATE OF WISCONSIN, MOTOR VEHICLE DEPARTMENT,
Madison, July 26, 1957.

Re seat belts in Wisconsin State patrol squad cars.

Hon. KENNETH A. ROBERTS,
Chairman, Special Committee on Traffic Safety of the Committee on Interstate and Foreign Commerce, House Office Building, Washington D. C.

DEAR SIR: In response to your letter of July 20, 1957, I wish to advise that all squad cars operated by this organization are equipped with seat belts. Realizing the importance of seat belts and feeling that we should take the lead in the use of automotive safety devices in Wisconsin, we have included seat belts as one of the requirements in all squad-car specifications since 1955. A directive has been issued that all personnel are to use seat belts when operating squad cars.

Our faith in the value of safety belts has been borne out in several accidents involving our squad cars where investigation showed that safety belts have prevented serious injury or death to patrol officers.

In one accident a patrol officer was severely injured because the seat belt broke. Tests were made by the special services section of the patrol indicating that the belt was defective, or damaged prior to the accident. A copy of the test report is attached. This report was not intended to cover a complete study of safety belts, but only of the belt in the patrol officer's car.

Prior to the purchase of the next group of cars we intend to require bidding companies to submit sample belts for testing and we anticipate including in the specifications the following:

Webbing: Aircraft specifications.

Buckle: Quick release with either hand type which can be tightened with one hand, thereby allowing driver to keep one hand on the wheel at all times; release lever fitting closely enough to webbing when engaged so as to minimize accidental releasing in case driver's arm is brushed across it while driving or in an accident.

Other metal fittings: Strong enough to withstand any strain to which the whole belts would be submitted in the course of squad car operation.

This will be our first attempt at establishing standards for our squad car seat belts and will also be the first step toward establishing standards for seat belt use by citizens of Wisconsin, should such standards be called for by legislation.

I hope the contents of this letter will be of some use to you in your studies on this matter. If this department can be of further service, do not hesitate to contact us.

It will be appreciated if a copy of the committee report can be supplied to this department.

Yours very truly,

L. E. BEIER,
Director, Enforcement Division.

STATE OF WISCONSIN, MOTOR VEHICLE DEPARTMENT

INTEROFFICE COMMUNICATION

JULY 26, 1957.

To: Col. L. E. Beier, enforcement division.
Re test of safety belt in Officer Czechowicz' squad car.

As a result of the accident involving Officer Czechowicz, question was raised as to the strength of the seat belt being used by him at the time of his accident. I obtained the broken seat belt from Officer Czechowicz' car and also obtained the same make belt from another 1957 Chevrolet squad car.

I made arrangements with Professor Easton, of the University of Wisconsin Engineering School, to test the tensile strength of these belts. These tests were made in the mechanical engineering laboratory at the University of Wisconsin. All tests were made under strain conditions which would be met by a pull against the belt in a car except a sudden jerk.

1. The anchor fitting which fastens the belt to the floor consists of a flat 2½-inch washer (part No. FD2429), a part through which the belt loops and through which the bolt passes to fasten it to the floor (part No. FD2430) and a 5/16-inch bolt and nut.

2. The buckle and hook fitting which snaps together at the waist when the belt is placed around the body (part No. FDC2500). The hook fits into the buckle and is released by a pull on a lever.

3. The clasp which is used to keep the ends of the belt from slipping (part No. ED1595–3). Each belt is equipped with two anchor fittings, 1 hook and buckle fitting, and 2 clasps. It is manufactured by the Davis Aircraft Products, Inc., of New York.

All tests were made with belt fittings attached except the last test shown below. Tests were made as follows:

I. Using undamaged belt: Belt broke at 1,760-pound pull but break occurred at the metal piece in the buckle over which the belt is looped. This metal piece is ridged and it was the opinion of Professor Easton, Professor Washa, and myself that the break was probably due to the cutting action of the ridges rather than a fault of the fabric itself. There was no other evidence of injury to the belt. The buckle was broken into several pieces beyond further use.

II. Using belt from Officer Czechowicz' car: The longest undamaged part of this belt was used. Fittings were attached just as though the belt was complete. The following results were obtained:

Test No. 1: Belt did not break but at 2,065-pound pull one of the anchor fittings broke.

Test No. 2: Belt did not break, but at 2,025-pound pull another anchor fitting broke.

Test No. 3: Inasmuch as we still had not obtained a breakage of the belt other than at a place where the fabric rubbed on metal we used a short piece of the fabric and made loops on each end by fastening the ends to the rest of the belt with clasps. When tension was applied the fabric started to slip through the clasps so we then affixed another set of clasps to double the friction. We applied tension again, and at 2,705 pounds, the fabric broke, but again at its junction with metal, so that we were again faced with the possibility of cutting action by the fitting.

Test No. 4: Because we could not get enough tension from a fitting I took a section of the undamaged belt devoid of fittings to a shoemaker and had a loop sewed on each end with nylon thread. Then by using a piece of round steel in each loop to avoid cutting action we were able to obtain enough pull to break the fabric itself at 3,785 pounds.

Inasmuch as aeronautical specifications require a tensile strength of 1,500 pounds for the fabric and 3,000 pounds for the complete belt we can readily see that the fabric used in these belts meets specifications, but the fittings do not.

In trying to apply these tests to the Czechowicz accident we find the paradox of the fittings remaining intact but the fabric breaking. The only apparent answer is that either the fabric in his belt was defective or it had been damaged at the breaking point previous to the accident. Because the fastings did not break, and were not even bent, we must assume that at no time did the strain on his belt exceed 2,000 pounds.

This is only a report on the particular belt being used by Officer Czechowicz. More exhaustive studies will be made prior to the next purchase of the squad cars.

Yours very truly,

Capt. R. G. CROMEY,
Special Services, Wisconsin State Patrol.

WYOMING HIGHWAY DEPARTMENT,
MOTOR VEHICLE DIVISION,
Cheyenne, Wyo., August 1, 1957.

Hon. KENNETH A. ROBERTS:
Chairman, Special Subcommittee on Traffic Safety,
House Office Building, Washington, D. C.

DEAR MR. ROBERTS: Seat belts were installed in Wyoming highway patrol cars 2½ years ago as we felt they would be an added protection to the officers in the types of accidents they seemed to be involved in—mainly sideswipes and turnovers.

We did not compel the officers to use the belt, therefore, its use and reception has been varied. The officers who consistently use the belt say it not only gives them a feeling of added security, but provides a brace against which they may relax, thus reducing driver fatigue.

The primary complaint against seat-belt use by the officers is the inconvenience when duties require getting into and out of their cars many times a day.

Since installing seat belts in our vehicles, we have not had any accidents of such severity by which we could definitely state the belt was a factor in preventing loss of life or injury to our personnel. Our accident records do, however, reveal that in several fatal and serious injury accidents, the victims may have been saved by seat belts, such as turnovers, where a car door opens and the victim is crushed; sideswipes, where driver or passenger is thrown from the car onto the roadway; and slight head on where passenger is thrown into or through the windshield.

Many of the accidents occurring to drivers in our State are high-speed head-on collisions, high-speed rear-end collisions, fixed-object collisions, and other high-speed actions. We feel, from our observations and experiences, that the protective value of any safety device is nullified by the high-speed type of collision.

I am sorry that our report on this subject is rather incomplete but our experience as to the crashworthiness of safety belts is rather limited.

Yours very truly,

Col. WILLIAM R. BRADLEY,
Wyoming Highway Patrol.

TERRITORY OF ALASKA DEPARTMENT OF TERRITORIAL POLICE,
Juneau, Alaska, July 25, 1957.

Hon. KENNETH A. ROBERTS,
Congress of the United States,
House of Representatives, Washington, D. C.

DEAR MR. ROBERTS: This will acknowledge receipt of your letter of July 20 relative to the use of automobile safety belts by this Department.

Our experience with seat belts is rather limited. We began 2 years ago to make their installation standard equipment in all of our new automobiles. Since that time there have been two automobile accidents involving our motor vehicles in which we credit these seat belts with having prevented serious injuries occurring to our officers.

I am personally convinced of their value as a safety measure.

I trust that this information may be of some assistance to you in your work. Please be assured of our cooperation in these matters of mutual interest and concern.

Very truly yours,

A. P. BRANDT, *Superintendent.*

(The following material was submitted by Maj. George O. Anderson, Chief, Engineering and Research Division, Assistant for Ground Safety, Deputy Chief of Staff, Personnel, Headquarters, U. S. Air Force:)

AIR FORCE REGULATION NO. 32-1

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *13 JANUARY 1956*

GROUND SAFETY

Air Force Ground Safety Program

***Purpose.** This regulation establishes the Air Force Ground Safety Program. It provides for an effective coordinated effort designed to increase and preserve the Air Force combat capability through the reduction or elimination of ground accidents causing manpower and materiel losses.*

1. What the Program Includes. This program includes in its area of responsibility accidents to:

a. Military personnel which cause injury or death throughout the 24-hour day regardless of where the accident occurs.

b. Air Force civilians, resulting from and during their employment, which cause injury or death.

c. Air Force materiel or property which damage or destroy the property.

d. Non-Air Force personnel or property, caused by Air Force ground operations, which injure or damage the personnel or property.

2. Responsibility. Commanders and supervisors at all levels of command will insure the effectiveness of the program and the enforcement of safety requirements. In general, the program will be accomplished through the scientific application of safety engineering principles; the investigation, reporting, and analysis of accident experience; the publication and dissemination of accident statistics; and continuous safety educational and training programs. To insure comprehensiveness and an orderly development of the program the areas of responsibility are defined below:

a. The Deputy Chief of Staff, Personnel, Headquarters USAF, is responsible for the Air Force Ground Safety Program. Acting for him the Assistant for Ground Safety will exercise staff supervision over all matters pertaining to the program and will advise the Deputy Chief of Staff, Personnel, on these matters. Headquarters USAF will:

(1) Develop and establish plans, policies, and procedures for administering the program.

(2) Coordinate ground safety activity and provide accident information to all Staff Offices which have accident prevention interests or are responsible for correcting unsafe personnel practices or procedures and unsafe physical conditions.

(3) Maintain liaison and exchange information with private, governmental, and industrial organizations having mutual safety interests to insure progressive development of the Air Force program.

(4) Develop safety education programs to further the safety consciousness and indoctrination of Air Force personnel. This includes developing and establishing specialized safety training courses as well as procuring and distributing educational, technical, and promotional material.

(5) Establish procedures for investigating, reporting, and analyzing ground accidents. This includes conducting special studies on ground accident occurrences to determine cause factors and requirements for preventive action.

(6) Provide safety engineering and research assistance within Headquarters USAF and to subordinate commands to insure the inclusion of safety factors in Air Force technical operations and developments.

b. Commanders of all commands and locations where military or civilian personnel are stationed or employed and equipment is used will establish an aggressive ground safety program. A professionally qualified ground safety director with adequate assistance is necessary to conduct such a program. The program will include adequate measures to:

(1) Plan, develop, and organize a comprehensive ground safety program and exercise staff supervision over all ground safety activity.

---

*This regulation supersedes AFR 32-1, 24 August 1948, including change 32-1A, 30 January 1951.

(2) Provide technical safety service to insure the inclusion of safety engineering standards in all ground operations and planning.

(3) Maintain a continuing safety education and promotion program to insure a high level of safety awareness and knowledge among all personnel.

(4) Conduct periodic and special surveys to determine unsafe practices, unsafe operating conditions, and inadequate safety programming.

(5) Insure complete and accurate investigation and reporting of ground accidents including the analysis and dissemination of data concerning accident experience and trends.

(6) Maintain a program of community relations in cooperation with local organizations having safety interests especially with regard to motor vehicle accident prevention.

3. Joint Occupancy of Installations. Each installation will have only one overall ground safety program. This program will be conducted by the element having command jurisdiction of the installation. Tenant units will be included in the program conducted by the installation and will comply with the ground safety policies established for the installation. Tenant unit commanders will appoint a representative to coordinate the safety activity and requirements of the unit with the installation ground safety director. Higher headquarters of tenant units will maintain command safety surveillance over such units and will provide additional direction as necessary to insure maximum safety. Accident experience and reporting summaries of tenant units will not be consolidated with those of the installation but will be reported through respective command channels.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

DISTRIBUTION:
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AIR FORCE REGULATION }
NO. 32-2 }

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *18 APRIL 1956*

GROUND SAFETY

Ground Accident Reporting and Analysis System

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*This regulation supersedes AFR 32-2, 11 March 1954.

SECTION A—GENERAL

1. Purpose. This regulation outlines the reporting procedures for collecting and analyzing data on Air Force ground accidents and establishes the minimum requirements of the Air Force ground accident reporting system. It is directive, and applies to all Air Force activities.

2. Significance of Ground Accident Reporting and Analysis. The collection and analysis of ground accident data is essential to the planning, development and execution of accident prevention programs at all levels. Standard methods have been prescribed to insure the uniform, accurate, and expeditious reporting necessary to support the "loss prevention" concept of Air Force management for which the program is designed. Ground Accident reports are prepared for accident prevention purposes only and are not to be construed as additions to or substitutes for reports which may be required by other directives.

NOTE: Major air commands may supplement procedures set forth in this regulation, but will issue no conflicting instructions.

3. Ground Accidents are those accidents which come under the responsibility of the Air Force Ground Safety Program as defined in AFR 32–1; they include all accidents occurring on or off an Air Force installation, base, or site which involve any of the following, singly or in combination: Air Force military personnel, on-duty Air Force civilian personnel, and/or Air Force property. Ground accidents are considered "reportable" if they involve disabling injury to personnel and/or property damage of $25 or more.

4. Definitions. For the purposes of this regulation, the following definitions will apply:

a. *Air Force Civilians*—On-duty citizens and/or residents of the United States, its Territories, and Canada, who are employed by the Air Force and are paid from appropriated funds.

b. *Air Force Driver*—Any person driving a USAF motor or special purpose vehicle or an Air Force military person or on-duty Air Force civilian employee driving any vehicle.

c. *Air Force Military Personnel*—Officers and airmen serving on extended active duty with the Air Force. Members of other United States military services serving on extended active duty with Air Force units are included as Air Force military personnel.

d. *Disabling Injuries:*

(1) *Fatality*—Injury that results in death.

SOME EXAMPLES OF REPORTABLE GROUND ACCIDENTS

(1) *Military personnel.* Any accident that occurs on or off an Air Force installation, base, or site, which results in disabling injury to Air Force military personnel.

(2) *Civilian personnel.* Any accident that occurs on or off an Air Force installation, base, or site, which results in disabling injury to an on-duty Air Force civilian employee, when the accident arises out of and in the course of his employment. This will include all accidents that occur while the employee is:

(a) traveling on a military installation in proceeding to or from his place of work;

(b) at work;

(c) on a military installation during his lunch hour or rest period;

(d) being transported in a Government vehicle to or from his place of assigned work, on or off a military installation;

(e) on temporary duty, actually performing official duty (but not off-duty activities), or while traveling on official orders to or from the site of his temporary duty.

(3) *Property Damage.* Any accident that occurs on or off an Air Force installation, base, or site, which results in Air Force property damage of $25 or more.

(4) *Ground Fires.* Any fire in which Air Force military and/or on-duty Air Force civilian personnel sustain disabling injuries.

(5) *Occupational Exposure.* Any accident in which Air Force military personnel and/or on-duty civilian personnel sustain disabling injury as a result of occupational exposure to vapors, chemicals, dusts, gases, rays, or similar agencies as diagnosed by Medical Services.

(6) *Damage from the Elements.* Any accident in which Air Force property is damaged as a result of the elements—that is, wind, hail, rain, etc. For reportability of accidents resulting from the elements and classified as "Acts of God", see paragraph 5, c (1).

(7) *Motor Vehicles.*

(a) Any accident involving an Air Force motor vehicle in operation and an Air Force aircraft.

(b) Any fire resulting from a reportable Air Force motor vehicle accident in which Air Force property is damaged.

(c) Any Air Force motor vehicle accident resulting in disabling injuries to non-Air Force persons and/or non-Air Force property damage of $25 or more.

(8) *Commercial Carrier.* Any licensed commercial carrier accident which results in disabling injury to an Air Force military and/or on-duty civilian person being transported by a licensed commercial carrier.

SOME EXAMPLES OF *NONREPORTABLE* GROUND ACCIDENTS

(All ground accidents are reportable except those specifically excluded in these examples.)

(1) *Air Force Aircraft.* Any accident incident to the flight of Air Force aircraft or any accident involving an Air Force aircraft with engine(s) running, except those involving an Air Force motor vehicle in operation.

(2) *Air Force Guided Missile (Pilotless Aircraft).* Any accident involving a missile that occurs after the missile is on the launch device with the Rato or power plant in operation.

(3) *Fire.* Any fire in which only property damage occurs except those resulting from a motor vehicle accident.

(4) *Fair Wear and Tear.* Property damaged by fair wear and tear.

(5) *Suicide and Murder.* (Attempted suicide or murder accidents are reportable. Determination of chargeability will be made by Assistant for Ground Safety, Headquarters USAF)

(6) *Intentionally Self-Inflicted Injuries.*

(7) *Drug, Food, or Beverages.* Illness resulting from the physiological effects of consuming a drug, or contaminated and/or excessive amounts of food or beverage.

(8) *Reactions to Drugs, Toxins, and/or Serums.* Reactions to drugs, toxins, serums, and/or other medical treatments prescribed by medical authorities.

(9) *Enemy Action.* Property damage and/or personnel injuries that are a direct result of enemy action.

(10) *Escaping from Apprehension or Custody.* Injuries to Air Force military and/or civilian personnel resulting from intentional failure to heed a challenge by a legal authority when attempting to escape after having been apprehended or placed in custody.

(11) *Non-Air Force Injuries and/or Property Damage.* Any accident resulting only in non-Air Force injuries and/or property damage, except a reportable Air Force motor or special purpose vehicle accident.

(12) *Recurrence of Injury.* Recurrence of injury previously reported to Headquarters USAF when the recurrence is not caused by a new accident.

(13) *Explosions.* Explosions caused by fire or involving Air Force aircraft with engine(s) running.

(2) *Permanent Total Disability*—Any nonfatal injury which, in the opinion of competent medical authority, permanently and totally incapacitates the injured person to the extent that he cannot follow any gainful occupation. The loss of or the loss of use of, both hands, both feet, both eyes, or any two of these as a result of a single accident, will be considered as a permanent total disability.

(3) *Permanent Partial Disability*—Any injury other than a fatality or permanent total disability when this injury, in the opinion of competent medical authority, results in the complete loss or permanent impairment of any member of the body or part thereof. If it is estimated that the injured will return to duty, the report will be classified and costed as a "temporary total" injury. (Hernia, loss of teeth, and loss of any toe other than the great toe, will not be considered as a permanent partial disability.)

(4) *Temporary Total Disability*—Any injury other than a fatality, permanent total disability, or permanent partial disability, which, in the opinion of competent medical authority, would prevent a military person from performing his regularly assigned duty, during the next calendar or any subsequent day and an Air Force civilian person from performing his regularly assigned duty on any subsequent duty day.

e. *Foreign National Personnel*—Citizens of a country other than the United States, its Territories, and Canada, who render services in connection with Air Force operations in that country or area, and are paid either directly or indirectly from United States appropriated funds and are on the installation payroll records.

f. *Installation Ground Safety Office*—The ground safety office operating the ground safety program of the installation as directed by AFR 32–1.

g. *Major Ground Accident*—A reportable ground accident which results in either of the following:

(1) Ten or more disabling injuries (including fatalities) to Air Force military personnel and/or on-duty Air Force civilian employees.

(2) Air Force property damage in excess of $50,000.

h. *MDAP Personnel*—Citizens of a country (other than the United States, its Territories, and Canada) that is a member of the Mutual Defense Assistance Pact and participates in an Air Force training program operated under the provisions of the Mutual Defense Assistance Pact.

i. *Non-Air Force Persons*—Persons other than on-duty Air Force civilians, foreign nationals, and MDAP personnel as defined in sub-

paragraphs 4a, e, and h. Persons employed by other Federal agencies and civilians who are paid out of nonappropriated funds (employees of Air Force Exchanges, officer's clubs, concessionaires, and so forth) will be considered as non-Air Force persons. Off-duty Air Force civilian employees and persons on short tours of active duty, such as Air Force Reserve, Air National Guard, or AFROTC, will be considered as non-Air Force persons.

j. *Nondisabling Injury*—A nondisabling injury is one which, although requiring medical attention, would not keep the injured person from performing his regularly assigned duties. This type of injury is generally known as a first-aid case. If a nondisabling injury is upgraded to a higher injury classification, the major air command having the injured person on its morning report at the time the nondisabling injury occurred will report the injury.

k. *Permanent Change of Station.* Intercommand. Reassignment of personnel from units or organizations of one major air command to units or organizations of another major air command. Personnel will be considered as in a permanent change of station status from the time they "sign out" at the organization of losing major air command until they "sign in" at the gaining organization of the other major air command.

l. *Private Motor Vehicle Accident*—A motor vehicle accident involving only non-Air Force motor vehicles, or, if both Air Force and non-Air Force motor vehicles were involved, the Air Force motor vehicle was not being operated at the time of the accident. Motor vehicles which are not Air Force property will be considered as private vehicles. Motor vehicles which are the property of Government agencies other than the Air Force will also be considered as private vehicles.

m. *Status*—Indicates whether or not the person involved in the accident was on or off duty and whether the accident occurred on or off a military installation.

(1) *On-Duty*—The status of any Air Force military and civilian persons under any of the following conditions:

(a) While performing official work assigned by competent authority. This can be any time during the day or night depending upon when the assigned work is to be performed.

(b) While on a military installation and on their lunch hour or rest periods during their work (on-duty) shift.

(c) While on a military installation and are proceeding to, or returning from, the site of their Air Force work.

(d) While being transported in a United States Government vehicle to or from the site of their assigned Air Force work on or off base.

(2) *Off-Duty*—The status of military persons when they are not in any of the "on-duty" conditions described in paragraph 4m(1). The "off-duty" status pertains only to military personnel and not to Air Force civilian employees. If an Air Force civilian employee living on an Air Force installation is injured while he is on that installation, but at a time when he is not in any of the "on-duty" categories as defined in paragraph 4m(1), the injury will be considered as an injury to a non-Air Force person.

(3) *Off-Base Accidents*—All Air Force ground accidents which do not occur on an Air Force installation, base, site, or on an installation of another United States military establishment.

(4) *On-Base Accidents*—All Air Force ground accidents which occur on an Air Force installation, base, or site. Air Force ground accidents which occur on an installation of another United States military establishment will be "on-base" accidents.

n. *USAF Motor Vehicle Accident:*

(1) A motor vehicle accident is a ground accident involving a motor vehicle, which is being operated as such, at the time the accident occurs. Motor vehicles will include:

(a) Passenger cars and station wagons.

(b) Ambulances and buses.

(c) Motorcycles, motor-bikes, and scooters (two- or three-wheel).

(d) Trucks and truck tractors (conventional types with or without special purpose equipment and/or whether or not towing trailers or other equipment).

(2) Motor vehicle accidents will include:

(a) Collision-type accidents such as a motor vehicle striking another motor vehicle, an object, and/or a pedestrian.

(b) Loss-of-control accidents such as motor vehicle running off road, skidding, overturning, and motor vehicles striking objects and/or people.

(c) Accidents involving persons falling in, falling from, or jumping from a moving vehicle.

(d) Accidents resulting from cargo shifting and/or falling from a motor vehicle while the vehicle is in operation, with the cargo being accordingly damaged and/or causing personnel injury and/or other property damage.

(e) Accidents incident to towing or pushing operations of motor vehicles or trailers by motor vehicles.

(f) Those accidents involving operating motor vehicles which result in disabling injury to any person.

(g) Those accidents involving operating motor vehicles which result in property damage of $25 or more.

(h) Any accident involving a stolen Air Force motor vehicle.

(3) A motor vehicle accident will *not* include:

(a) Any accident in which personnel sustain injuries while loading or unloading and mounting or dismounting a motor vehicle which is not moving.

(b) Any accident involving a motor vehicle cargo being directly damaged by weather conditions.

(c) Any accident resulting from the operation of special-purpose equipment whether or not self-propelled —for example, tugs, road graders, fork-lifts, etc.

(d) Any accident resulting from operation of the special-purpose equipment mounted on a motor vehicle chassis. In an accident involving a motor vehicle on which special purpose equipment is mounted, the accident will not be a motor vehicle accident if it was incident to the operation of the special-purpose equipment and not to the operation of the motor vehicle.

(e) Any accident in which a properly parked USAF motor vehicle is damaged, except when damaged by another USAF motor vehicle.

(f) Any accident in which people are injured while working on or near a motor vehicle which is not moving; for example, a mechanic's hand being caught in a fan belt.

(g) Any accident involving a fire truck, except those involving an operating USAF motor vehicle. (Fire truck accidents will be reported as special purpose vehicle accidents.)

o. *USAF Special Purpose Vehicle Accident:*

(1) A special purpose vehicle accident is a ground accident involving a special purpose vehicle, which is being operated as such, at the time the accident occurs. Special purpose vehicles will include all vehicles except those designated as motor vehicles in paragraph 4n(1).

(2) Special purpose vehicle accidents will include:

(a) Collision-type accidents, such as a special purpose vehicle striking another special purpose vehicle, a properly parked motor vehicle, an object and/or an Air Force military and/or on-duty civilian pedestrian.

(b) Loss-of-control accidents, such as a special purpose vehicle running off a road, skidding, upsetting, overturning, striking objects and/or Air Force military and/or on-duty civilian pedestrians.

(c) Accidents involving persons falling in, falling from, or jumping from a moving special purpose vehicle.

(d) Accidents resulting from cargo shifting and/or falling from a special purpose vehicle while the vehicle is in operation, with the cargo being accordingly damaged and/or causing Air Force personnel injury and/or property damage.

(e) Accidents incident to towing or pushing operations of special purpose vehicles or trailers by special purpose vehicles.

(f) Those accidents involving an operating special purpose vehicle which result in disabling injury to an Air Force military and/or on-duty civilian person.

(g) Those accidents involving an operating special purpose vehicle which results in Air Force property damage of $25 or more.

(h) Any accident involving an operating special purpose vehicle which results in disabling injury to a non-USAF person and/or non-USAF property damage of $25 or more.

(3) A special purpose vehicle accident will *not* include:

(a) Any accident in which personnel sustain injuries while loading or unloading and mounting or dismounting a special purpose vehicle which is not moving.

(b) Any accident involving special purpose vehicle cargo being directly damaged by weather conditions.

(c) Any accident involving an operating motor vehicle and a special purpose vehicle.

(d) Any accident in which people are injured while working on or near a special purpose vehicle which is not moving; for example, a mechanic's hand being caught in a fan belt.

5. Basis of the Air Force Ground Accident Reporting System:

a. *Personnel Injury Accountability*—Air Force military and civilian personnel injury losses are reportable by and chargeable to the command to which the person reported was assigned at the time of the occurrence of the accident. This will be determined from the morning report for Air Force military personnel and the payroll records for Air Force civilian personnel.

b. *Accident Chargeability*—Ground accidents are reportable by, and chargeable to, the command or organization to which the person most responsible for the accident was assigned at the time the accident occurred.

c. *Property Damage Responsibility*—Property damage resulting from a ground accident is reportable by, and chargeable to, the command to which the person most responsible for the accident was assigned at the time the accident occurred. However, property damaged by non-USAF or unknown persons will be reportable by, and chargeable to, the owning command.

NOTE: Certain types of reportable Air Force ground accidents may be excluded from rate computations and costs, *subject to approval by Headquarters USAF*. These accidents will be reported in the normal manner, except that a sheet of paper containing the words "NOT CHARGEABLE" will be placed on top of the report. Accidents in this category will include:

(1) *Acts of God*—Injury and/or property damage resulting from rain, hail, lightning, tornado, etc., which was either unpredicted or beyond control.

(2) *Commercial Carrier*—A licensed commercial carrier accident that results in injury to Air Force military and/or on-duty civilian personnel being transported by the commercial carrier.

(3) *Permanent Change of Station*. Injury to Air Force military personnel on a permanent change of station between two major air commands.

(4) *Other*—Any reportable accident in which there is a *reasonable question* concerning its chargeability.

6. Notification of Ground Accident Occurrence:

a. *All Ground Accidents*. Procedures will be set up at every Air Force installation, base, or site, to insure that the ground safety director is promptly notified when a ground accident occurs. These procedures will include the establishment of a system for correlating motor vehicle accident reports with the Provost Marshal (AFR 125-14) and personal injury with the Medical Services. In carrying out these procedures, prompt notification will be the responsibility of one of the following persons, as appropriate:

(1) The supervisor immediately in charge of the Air Force operation, or, if there was no direct Air Force supervision,

(2) The supervisor of the person injured in the accident (in the case, for example, of an off-duty, off-base accident), or

(3) The supervisor responsible for the property that was damaged.

b. *Major Ground Accidents*. Upon notification that a major ground accident has occurred within his jurisdiction, the installation commander will immediately report the general details, by electrical transmission, directly to the Assistant for Ground Safety, Headquarters USAF. These details will include, in brief outline form, the general circumstances of the accident and the estimated fatalities, other disabling injuries, and/or property damage. Additional copies of the message will be transmitted to other command echelons as the major air command involved may direct. After the notification of occurrence has been transmitted, an AF Form 122 will be prepared and submitted in accordance with the provisions of this regulation.

7. Investigation of Ground Accidents:

a. *Accidents Involving Air Force Ground Operations*. Each ground accident involving Air Force ground operations will be investigated to determine the cause or causes, any losses that

result, and to take appropriate corrective measures to prevent recurrences. The investigation will be conducted jointly by qualified ground safety personnel and the supervisor of the operation in which the accident was sustained. This does not preclude an investigation by other interested agencies.

b. *Accidents Not Involving Air Force Ground Operations.* A reportable ground accident that occurs off-base and does not involve Air Force ground operations may be investigated at the discretion of the installation commander. He may, at his option, make use of investigations by other military or civilian agencies.

SECTION B—AF FORM 122, "REPORT OF GROUND ACCIDENT," RCS: 1-AF-X11

8. Responsibilities for Report Preparation. The following personnel have responsibilities as indicated in connection with the preparation of AF Form 122, "Report of Ground Accident". The use of AF Form 122, in lieu of Standard Forms 91a and 92, has the approval of the Bureau of the Budget".

a. *Installation Commander.* The installation commander will insure that an AF Form 122, "Report of Ground Accident," is prepared on every reportable ground accident that occurs on, or is first reported to, his installation.

b. *Ground Safety Personnel.* The report will be prepared by ground safety personnel.

c. *Supervisor and/or Other Persons Concerned.* Immediate supervisors and/or any other person concerned with a reportable ground accident will assist ground safety personnel in preparing the report.

9. Assigning Report Numbers. Each ground accident report will be permanently identified by an assigned number. After the submission of Ground Accident Reports, and the Ground Accident Summary for a report period, the original report numbers will not be changed without approval of Hq USAF. Major air commands will designate the organizations within the echelon of command that are authorized to assign numbers to reports. (See Notes 3, 4 and 5 to Figure 1 for additional information on how these numbers are assigned.)

10. Losses to Two or More Organizations. If a reportable ground accident results in losses to several organizations, each organization incurring a chargeable loss will prepare and forward a complete AF Form 122.

11. Supplemental Reports. If, after a numbered report has been forwarded by an installation, the injury classification of any person reported should change, a supplemental report will be prepared, numbered the same as the original report, but the word "Supplemental" written on the top margin of the page. The report need not be completely recopied, but should show only the required changes. Supplemental reports will be due in the Assistant for Ground Safety, Headquarters USAF, on or before the 30th calendar day after the day of the accident. The original and supplemental report will both be filed under the original number.

12. Deleted Numbers. If a report number is assigned to an accident that is later found to be nonreportable (after the report has been forwarded), the number will be shown in the records as deleted. A number, once deleted will not be assigned to another accident during the month under any circumstances. Deleted numbers will be reported every month on AF Form 122a (see paragraph 15), along with a brief explanation of the reason for cancellation.

13. Specific Instructions for Filling Out AF Form 122. This paragraph gives the specific information required in filling out AF Form 122 correctly. In the illustrations, which depict a part of the report, there will be numbered "Notes" referring to specific blocks or spaces of the report. These notes are keyed to the report to give in the simplest form possible, a complete explanation of the material to be put in the report.

Note 1 PAGE OF PAGES

GROUND ACCIDENT REPORT (Attach additional sheets of 8 x 10½ paper, if required)				REPORTS CONTROL SYMBOL Note 2
1. REPORT IDENTIFICATION				
1 BASE CODE Note 3		MONTH Note 4		SERIAL NUMBER Note 5
2 A. MAJOR COMMAND Note 6	B. SUBCOMMAND Note 7	C. BASE OR INSTALLATION Note 8	D. ORGANIZATION (Sqdn., Unit, Etc.,) Note 9	E. ORGANIZATION CODE Note 10

FIGURE 1

Note 1—Consider each added sheet required for this report as a page of the report, and number consecutively. Include exhibits and photographs as numbered attachments.

Note 2—Reports Control Symbol assigned to AF Form 122 is 1–AF–X11.

Note 3—Enter the SC 25 station code (as listed in AFM 171–5) of the installation on which the organization numbering the report is physically located.

Note 4—Enter the month in which the accident was reported and included on AF Form 122a. Indicate the month by 01 for January through 12 for December.

Note 5—Organizational units that are authorized to assign report numbers may be given permanent blocks of numbers (assigned by the major air command) for their exclusive use, month after month. The first report made each month on a reportable ground accident is assigned the first three-digit number of the permanent block, for example, "001." As additional accidents occur and are reported during the month, numbers are assigned consecutively. EXAMPLES: Unit "A" is assigned numbers 001 through 099, to be used and reused month after month. Unit "B" is assigned numbers 100 through 199 to be used and reused in the same fashion.

Note 6—Enter the symbol of the major air command submitting the report to Headquarters USAF. EXAMPLES: SAC (Strategic Air Command); TAC (Tactical Air Command), etc.

Note 7—Enter the name of the subcommand submitting the report to the major air command headquarters. EXAMPLES: 10th Air Force; Air Rescue Service; Oklahoma City Air Materiel Area; etc.

Note 8—Enter the name of the base or installation submitting the report to the subcommand or major air command headquarters. EXAMPLES: Bolling Air Force Base; Miami IAP.

Note 9—Enter the name of the squadron, unit, or other organization submitting the report to the subcommand or major air command headquarters. The specific level of organization unit shown will be at the discretion of the major air command concerned. EXAMPLES: 1st Shoran Beacon Squadron; 36th Fighter Bomber Squadron; 3415th USAF Hospital; etc.

Note 10—Enter the code assigned to the organization shown in block 2D. (This code is assigned by the major air command headquarters for its own use, and may be omitted at the command's discretion.)

11.	GENERAL ACCIDENT INFORMATION		
	DAY, DATE, MONTH, YEAR	MILITARY TIME	EXACT LOCATION OF ACCIDENT
3	Note 11	Note 12	Note 13
	DESCRIPTION OF ACCIDENT *(Give complete description, attach additional pages, if required)*		
4	Note 14		
	LIST UNSAFE CONDITIONS CONTRIBUTING TO ACCIDENT *(mechanical, weather, surface, etc.,)*		
5	Note 15		

FIGURE 2

Note 11—Enter the complete date, including the day of the week, the day of the month, the month, and the year. EXAMPLES: Thursday, 1 December 1955; Tuesday, 24 January 1956.

Note 12—State the actual or estimated time of occurrence of the accident, to the nearest military hour. EXAMPLES: 0800, 1300, 1900.

In occupational disease reports (dermatitis, inhalation of toxic fumes, etc.) leave this block blank, entering only the (actual or estimated) day of the week and date on which the condition became acute, as determined by Medical Services.

Note 13—Give enough information to describe the scene and exact location of the place where the accident occurred. EXAMPLES: Building

T–1, Airmen's barracks; Building H–11, aircraft hangar; Softball field; Foodball field; etc.

Do not use building numbers without designating the type of building.

Note 14—Give a complete, detailed description of what happened, how it happened, why it happened, specify unsafe acts and who committed them, or any unsafe personal factors that contributed to the cause of the accident. Reasonable inferences and assumptions may be made, if properly identified. Additional narratives, sketches, copies of "Unsatisfactory Reports," and photographs should be prepared to present a complete picture of the accident, numbering attachments consecutively.

Note 15—Specify any unsafe mechanical or physical conditions that may have contributed to the cause of the accident. When an unsafe mechanical condition is reported give the complete nomenclature of the equipment involved.

III. (TO BE COMPLETED ONLY ON RECEIPT OF SPECIAL INSTRUCTIONS FROM GROUND SAFETY, HEADQUARTERS, USAF)		
6	A. Note 16	B. Note 16

FIGURE 3

Note 16—Do not make any entries in this space unless special instructions have been received from the Assistant for Ground Safety, Headquarters USAF. This space is reserved for special studies that may be made from time to time. Since this is a constantly changing requirement, instructions will be issued according to the situation.

IV. PERSON REPORTED NO. 1 (Complete sections 3 thru 7 for vehicle 1)

A. NAME, GRADE, SERIAL NUMBER: Note 17			B. ASSIGNED ORGANIZATION (Base, Command): Note 18	C. SEX: Note 19	D. AGE: Note 20
E. PRIMARY AFSC: Note 21	F. STATUS: Note 22 — ON DUTY (On base) / ON DUTY (Off base) / OFF DUTY (On base) / OFF DUTY (Off base)		G. SCHOOL GRADE COMPLETED: Note 23	H. AERO RATING: Note 24	I. PRE-EXISTING PHYSICAL LIMITATIONS: Note 25
J. DUTY ASSIGNMENT: Note 26	K. FUNCTIONAL AREA: Note 27	L. ACTIVITY AT TIME OF ACCIDENT: Note 28	M. DESCRIBE UNSAFE ACT AND/OR UNSAFE PERSONAL FACTOR: Note 29		
7 N. INJURY (Nature and location, non-medical terms preferred): Note 30			O. DISABILITY CLASSIFICATION: FATAL Note 31 / PERMANENT PARTIAL / PERMANENT TOTAL / TEMPORARY TOTAL	P. DAYS LOST (Est): Note 32	
Q. POSITION IN VEHICLE: Note 33 (FRONT / REAR)	R. THROWN FROM VEHICLE: YES Note 34 NO	S. AREA OF IMPACT: Note 35 (FRONT / REAR)	T. OCCUPANTS IN VEHICLE — FRONT / BACK: Note 36	U. DRIVER VIOLATION: Note 37	
V. SPEED — LEGAL / ACTUAL: Note 38	W. WEATHER AND VISIBILITY: Note 39	X. TYPE, CONDITION OF ROAD SURFACE: Note 40	Y. VALID PERMIT — STATE / USAF: Note 41 — YES / NO		

AF FORM DEC 58 122 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. EXCEPTION TO STANDARD FORMS 91A AND 91 APPROVED BY BUREAU OF BUDGET, NOVEMBER 1950.

FIGURE 4

Note 17—Enter the name, grade and serial number (service number for Air Force military personnel; clock number, badge number, or other identification number for Air Force civilian personnel) of *one* of the following:

(a) the driver (whether injured or not) of USAF motor vehicle No. 1 (see Note 35) involved in a reportable vehicular accident; or

(b) the driver (whether injured or not) of USAF special purpose vehicle No. 1 (see Note 35) involved in a reportable vehicular accident; or

(c) the Air Force driver (military or on-duty civilian, whether injured or not) of private motor vehicle No. 1 (see Note 35) involved in a reportable vehicular accident; or

(d) the injured Air Force military or on-duty civilian person (pedestrian or passenger in a *private* automobile) involved in a reportable vehicular accident; or

(e) the injured Air Force military or on-duty civilian person involved in a reportable nonvehicular accident; or

(f) the Air Force military or on-duty civilian person (whether or not injured) most responsible for, or most closely associated with, a reportable Air Force property damage accident.

The above categories (a) through (f) are in order of precedence. *Choose the person highest on this list* for line 7; if there are additional persons involved, choose the second highest for line 8, the third highest for the first added "tab," and so on.

The following chart contains additional instructions that will be of assistance to you in filling in this section of the report. Study it carefully, giving particular attention to the material concerning Foreign National and non-USAF persons.

Note 18—Enter the name of the base or installation and the name of the major air command to which the person reported was assigned at the time of the occurrence of the accident. (To obtain this information, use the morning report for military personnel, and payroll records for civilian employees.)

Note 19—Indicate whether person reported is male or female by entering the letter "M" or "F" as appropriate.

Note 20—Indicate age of the person reported to the nearest year.

Note 21—Indicate the primary Air Force Specialty Code (as shown in AFR 35–400) for military personnel, whether or not the person reported was actually working in his specialty. Indicate the Air Force Specialty Code equivalent to the trade or job of civilian employees.

Note 22—Indicate, by an "X" in the appropriate box, whether the person reported was on-duty or off-duty, and whether the accident occurred on or off a military installation. (See paragraph ——— for additional information in filling out this blank.)

Note 23—Show the total number of school years the person reported has completed. For example, a person who has completed an 8th grade education would be entered as "8." A high school graduate who has completed three years of college would be shown as "15."

Note 24—Indicate the aeronautical rating of the person reported. EXAMPLES: Pilot, Observer, Navigator, Aerial Engineer, Radio Operator. If none, so indicate.

Note 25—Describe any physical condition of the person reported which existed before the occurrence of the accident and contributed to the cause of the accident. Any indication that the person reported has been drinking intoxicating beverages, taking drugs, was in a state of unusual fatigue, etc., should be shown in this block.

Note 26—State the occupational title of the permanent, primary job assignment (as shown in AFR 35–500) of the person reported. EXAMPLES: Carpenter, Cook, Aircraft Mechanic. Do not consider temporary details or additional duty assignments.

Note 27—State the organizational function to which the person reported is assigned. EXAMPLES: Supply, Food Service, Medical, Motor Pool, Air Installations.

Note 28—Briefly describe what the person reported was doing at the time of the accident. EXAMPLES: Driving vehicle, Playing basketball, Climbing ladder.

Note 29—Describe any action (or lack of action) and/or any personal characteristic of the person reported which, in whole or in part, contributed to the cause of the accident. EXAMPLES: Failure to use safety device or wear safety attire: Using unsafe hand tools: Standing on makeshift instead of proper ladder; Disregard of instructions; Inattention; Inadequate supervision or experience.

Note 30—Briefly describe the nature and location of the injury sustained by the person reported. This description should be based on the opinion of competent medical authority, and written in nontechnical terms. EXAMPLES: Broken left leg; Amputated right arm; Deep cut over right eye. If the person reported was not injured, write "NOT INJURED" in this block and leave blocks "O" and "P" blank.

Note 31—Check the appropriate box for the correct injury classification with an "X." (See paragraph 4d for further information in making this entry.)

> CHANGES IN INJURY CLASSIFICATION. If, after a report has been numbered and forwarded, the injury classification changes, a supplemental report will be prepared. This report will be numbered the same as the original, but will contain the word "SUPPLEMENTAL" on the top margin. It will not be filled in completely, but will show only the required changes. Supplemental reports will be due in to the Assistant for Ground Safety, Headquarters USAF, on or before the 30th calendar day after the day of the accident. The supplemental report *will be filed* in the same file as the original.

Note 32—Show the estimated time lost in number of whole days. This estimate will be made as soon as possible after the temporary total disability occurs (time loss will not be assigned to fatalities, permanent total disabilities, permanent partial disabilities, or nondisabling injuries) on the basis of the opinion of competent medical authority. (If the opinion of an Air Force medical authority and that of another medical authority conflicts, the Air Force opinion will hold.)

For military personnel, show the estimated number of full calendar days that the injured person is unable to report for regularly assigned duty as a result of a temporary total injury, beginning with the first day after the injury and continuing up to, but not including, the date of return. The time a military person is under observation by medical authorities to determine the extent of his injuries, and any time that might be granted for convalescent leave, will be included in the time loss.

For civilian personnel, show the estimated total number of duty days that the injured person will be unable to report for work as a result of a temporary total injury beginning with the first duty day he is unable to report for work and continuing up to, but not including, the date of return. Sick leave, annual leave, and legal paid holidays will be included in the time loss.

CHART NO. 1

(Reportable) Type of Accident	Person Most Responsible	Block A	Blocks B through R	Blocks S through Y
AF motor vehicle No. 1 (If more than one vehicle involved, use line 8 and extra tabs as required.)	AF military driver	Name, grade and serv. no.	Fill in completely	Fill in completely
	AF on-duty civilian driver	Name, grade and badge no., clock no., etc.	Fill in completely	Fill in completely
	Foreign National driver	"FOREIGN NATIONAL DRIVER"	Omit	Fill in completely
	Non-USAF Driver	"NON-USAF DRIVER"	Omit	Fill in completely
AF special-purpose vehicle No. 1	Same instructions apply as for AF motor vehicle. If both motor vehicle(s) and special-purpose vehicle(s) are involved, motor vehicle info is filled in in line seven, special-purpose vehicle info in line 8, regardless of which driver was most responsible for the accident. Use extra tabs for additional vehicles.			
Private motor vehicle (If AF and private motor vehicles are involved, fill in info for AF vehicle on line 7, private vehicle on line 8. Use extra tabs for additional vehicles	AF military driver	Name, grade and serv. no.	Fill in completely	Fill in completely
	AF on-duty civilian driver	Name, grade and badge no., clock no., etc.	Fill in completely	Fill in completely
	Foreign National Driver	Name, grade and serv. no. of injured AF mil. or on-duty civ. passenger or pedestrian.	Fill in completely	Fill in as completely as possible for vehicle No. 1
	Non-USAF Driver	Name, grade and serv. no. of injured AF mil. or on-duty civ. passenger or pedestrian.	Fill in completely	Fill in as completely as possible for vehicle No. 1
Nonvehicular accident, injured AF personnel	AF military person	Name, grade and serv. no.	Fill in completely except blocks Q and R	Omit
	AF on-duty civilian	Name, grade and badge no. etc.	Fill in completely except blocks Q and R	Omit
	List additional injured personnel on line 8 and additional flaps			
AF Property Damage	AF military or on-duty civilian person	Name, grade and serv. or badge no., etc.	Fill in completely except blocks Q and R.	Omit
	Foreign National	"FOREIGN NATIONAL"	Omit	Omit
	Non-USAF Person	"NON-USAF PERSON"	Omit	Omit

Time loss will be maintained on record as originally estimated at the time the report is prepared and forwarded. Discrepancies between estimated and actual time loss will not be considered.

Note 33—Indicate with "X" the position in vehicle of the person reported. Leave blank for nonvehicular accidents.

Note 34—Indicate with "X" whether or not the person reported was thrown from vehicle. Leave blank for nonvehicular accidents.

Note 35—Indicate with "X" the area of initial impact on Motor Vehicle No. 1. Leave blank for nonvehicular accidents.

IDENTIFYING VEHICLES—WHICH IS VEHICLE NO. 1?

All vehicles, whether Air Force or private, should be identified. The following instructions will apply:

(a) If a single Air Force motor vehicle was involved in the accident, identify that vehicle as "Vehicle No. 1."

(b) If more than one Air Force motor vehicle was involved, "Vehicle No. 1" will be the vehicle of the Air Force driver who was primarily at fault or who contributed most to the cause of the accident.

(c) If an Air Force motor vehicle in operation was involved in an accident with an Air Force special purpose vehicle, the motor vehicle will be identified as "Vehicle No. 1," regardless of which driver was primarily at fault.

(d) If an Air Force motor vehicle was not involved in the accident, consider the single private motor vehicle driven by an Air Force driver as Vehicle No. 1. If several private motor vehicles were involved driven by Air Force persons, identify that vehicle whose Air Force driver was primarily at fault or contributed most to the cause of the accident as Vehicle No. 1.

(e) If neither an Air Force nor a private motor vehicle was involved in the accident, consider the single Air Force special purpose vehicle driven by an Air Force driver as Vehicle No. 1. If several such vehicles were involved, identify that vehicle whose driver was primarily at fault or who contributed most to the cause of the accident as Vehicle No. 1.

(f) Identify all vehicles involved in the accident other than Vehicle No. 1 as Vehicle No. 2, Vehicle No. 3, etc., without regard to precedence or order.

Note 36—Indicate in the appropriate block the number of occupants in the front and rear seats (or front and rear of truck bed, if appropriate) of Vehicle No. 1. Leave blank for nonvehicular accidents.

Note 37—Indicate any violation of law or safe driving practice by the driver of Vehicle No. 1. EXAMPLES: Speeding, Passing on curve, Weaving. Leave blank for nonvehicular accidents.

Note 38—Indicate in the appropriate block the legal speed at the scene of the accident, and the actual or estimated speed of Vehicle No. 1 just before the accident occurred. Leave blank for nonvehicular accidents.

Note 39—Describe the weather and visibility, such as "Day or Night," "Light drizzle and foggy," "Fair and clear," "Snowing and restricted," etc.

Note 40—Describe the type and condition of the road surface on which the accident occurred, such as "wet concrete—good," "icy dirt—rutted," "Dry, gravel—good," etc.

Note 41—Indicate, by entering an "X" in the appropriate block, whether or not the person reported is the holder of a valid state operator's permit and/or a USAF permit. Leave blank for nonvehicular accidents.

Note 42—Observe that the section of the report shown in Figure 5 is set aside for information about "Person Reported No. 2." Therefore, while the "Notes" referred to in Figure 5 are applicable in regard to the type of information required in each individual block, use caution and substitute "Person reported No. 2" for "Person reported No. 1" in all blocks where an asterisk appears. Substitute "Vehicle No. 2" in all blocks where double asterisk appears.

Note 43—Enter the name, rank and serial number (service number for Air Force military personnel; clock, identification, or badge number for civilian personnel) of:

(a) the driver of USAF Motor Vehicle No. 2 (whether injured or not) if the accident was a reportable motor vehicle accident; or

(b) the driver of Air Force special purpose vehicle No. 2 (whether injured or not) if the accident was a reportable special purpose vehicle accident; or

(c) the driver of private motor vehicle number 2 (whether injured or not) if the accident was a reportable private motor vehicle accident and the driver was an Air Force military person or an on-duty Air Force civilian; or

(d) the injured Air Force military or on-duty civilian person (pedestrian or passenger) involved in a reportable vehicular accident; or

(e) the injured Air Force military person or on-duty Air Force civilian involved in a reportable nonvehicular accident.

If more Air Force personnel, military or on-duty civilians, were involved in the accident, use additional "tabs" as required.

In accidents involving more than 2 vehicles, use additional "tabs" as required.

Note 44—Show information on all vehicles (Air Force and private) which are involved in a reportable accident. Information pertaining to Air Force vehicles should be complete; information pertaining to private vehicles should be as complete as circumstances permit.

Note 45—Place an "X" in the appropriate box to indicate whether vehicle being described is a motor vehicle or a special purpose vehicle (see paragraph 4*n*,*o*, "Definitions.")

Note 46—Indicate the owner of the vehicle. EXAMPLES: "Strategic Air Command"; "Department of Commerce"; "Mr. Ralph Jones." Also indicate the name of the owning Air

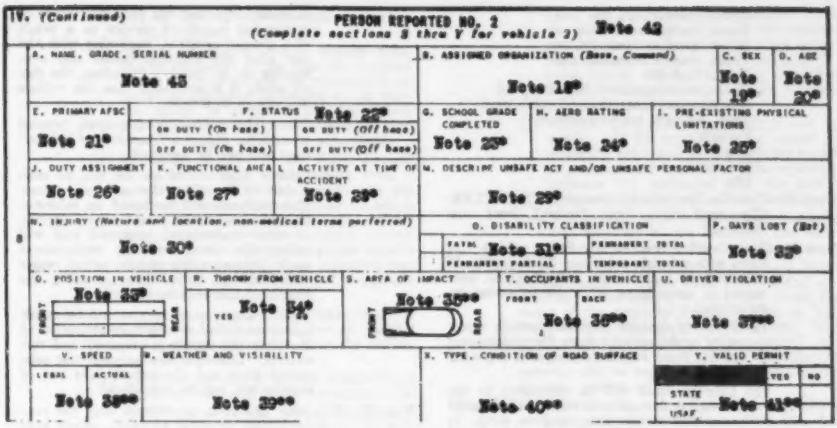

FIGURE 5

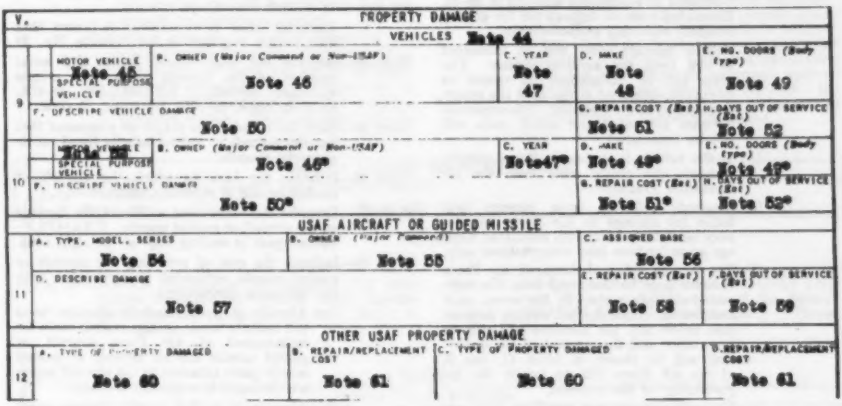

FIGURE 6

Force base or installation if the accident involved losses to two or more installations within the same major air command.

Note 47—Indicate the model year of the vehicle, for example, "1964."

Note 48—Indicate the standard trade name of the vehicle. EXAMPLES: "Chevrolet"; "Ford"; "Plymouth".

Note 49—Enter the number of doors, such as "2" or "4." Also indicate the body style (do not use letters or abbreviations to identify body styles).

EXAMPLES:

Ambulance, ¾ ton
Automobile, sedan, 5 passenger
Automobile, Station Wagon
Bus, 3½ ton
Truck, jeep, ¼ ton
Truck, carryall, ½ ton
Truck, pickup, ½ ton
Truck, weapons carrier, ¾ ton
Truck, cargo, 1½ ton
Truck, dump, 1½ ton
Truck, stake or platform, 1½ ton

Truck, tractor, 1¼ ton
Truck, tractor semitrailer
Truck, gasoline tank, 2½ ton
Truck, tractor refueling unit
Truck, high-lift
Crane, truck-mounted, ¾ cubic yard
Scraper, road motorized, 12 cubic yard
Tank, asphalt, trailer-mounted
Forklift
Tug
Bulldozer
Etc.

Note 50—Describe the vehicle damage. EXAMPLES: "Damaged right front fender," Bent rear Bumper."

Note 51—If the vehicle was an Air Force vehicle (for notes with asterisk, substitute "Vehicle No. 2" information) indicate the cost of repair, estimated in accordance with the following instructions:

(a) Property damage cost will include repair costs or depreciated costs for replacement of Air Force vehicles damaged in a ground accident.

(b) Damage costs will be estimated to the nearest dollar and will include all tangible costs for labor, parts, and so forth, to effect repairs. The estimate will be based upon information obtained from qualified supply, maintenance, or other operational personnel in accordance with AFM 66-12. Estimated costs of damage are for ground accident reporting purposes only.

(c) Vehicle damage costs will be estimated at the time the accident occurs. The costs will be maintained on record as originally estimated at the time the report is prepared and forwarded. Discrepancies between estimated and actual costs will not be considered.

(d) If the vehicle is a non-Air Force vehicle, estimate the repair costs from the information available.

(e) Amounts collected from persons held liable for damage to Air Force vehicles may be deducted from the estimated damage costs for base cost computations only.

(f) Net salvage value of damaged Air Force vehicles may be deducted from the estimated damage costs. In the event such deductions reduce the net vehicle damage cost below $25, the accident will still be reportable, and the amount of the deduction will be shown in block G, line 9, of the AF Form 122, to justify the reportability of the accident.

(g) Property damage cost resulting from vehicle accidents will be recorded on the accident records of the organization to which the person most responsible for the accident was assigned at the time of the accident, regardless of property ownership. However, USAF vehicles damaged by non-USAF or unknown persons, will be reported by, and charged to, the owning command.

Note 52—If the vehicle is an Air Force vehicle, indicate the estimated days out of service, making your estimate in accordance with the following instructions:

(a) Air Force vehicle "days out of service" will be the estimated total number of calendar days that the particular piece of equipment is out of service as a result of a ground accident, beginning with the day after the accident occurs and continuing up to, but not including, the day on which it is estimated that the vehicle will return to service.

(b) When the vehicle is destroyed beyond economical repair, a "days out of service" time will not be assigned.

(c) Vehicle days out of service will be estimated at the time the accident occurs. This estimate will be based on information obtained from maintenance, supply, or other operational personnel and will reflect the time awaiting replacement parts, time awaiting repairs, actual repair time, and all other time preceding the return of the vehicle to service.

(d) Vehicle days out of service will be maintained on record as originally estimated at the time the report is prepared and forwarded. Discrepancies between the estimated time and the actual days out of service will not be considered.

Note 53—Complete line 10 in accordance with the procedures shown in notes 45 to 52, except that information shown will pertain to Vehicle No. 2. If additional flaps are used, the first flap will pertain to Vehicle No. 3, the second to Vehicle No. 4, etc.

(Asterisk after note number indicates that information required is for Vehicle No. 2)

Note 54—Indicate the type, model, series and serial number of the aircraft or guided missile (pilotless aircraft). EXAMPLES: B-47A, 53-1770, F86A, 52-1077, Matador, 55-0006.

Note 55—State the name of the major air command that has the aircraft or guided missile listed on its property records.

Note 56—Indicate the base to which the aircraft or guided missile is normally assigned.

Note 57—Describe the extent and nature of the damage to the aircraft or guided missile. EXAMPLE: 10-inch gash in trailing edge of the right wing.

Note 58—Indicate the cost of repairing the aircraft or guided missile, estimated in accordance with the following instructions:

(a) Aircraft or guided missile damage costs will include repair or depreciated costs for replacement of Air Force aircraft or guided missile and/or aircraft or guided missile parts attached to the aircraft which are damaged in a ground accident.

(b) Aircraft or guided missile damage costs will be estimated to the nearest dollar and will include all tangible costs for labor, parts, and so forth, to effect repairs. The estimate will be based upon information obtained from qualified supply, maintenance, or other operational personnel. Estimated costs of damage are for ground accident reporting purposes only. They are not intended to apply to cost calculation procedures prescribed by any other staff activity.

(c) Amounts collected from persons held liable for damage to Air Force property may be deducted from the estimated damage cost for base cost calculations only.

(d) Net salvage value of damaged equipment or supplies may be deducted.

(e) Aircraft or guided missile damage costs will be estimated at the time the accident occurs. The costs will be maintained on record as originally estimated at the time the report is prepared and forwarded. Discrepancies between the estimated and the actual costs will not be considered.

(f) Estimated damage to Air Force aircraft or guided missile which results from a ground accident will be recorded on the accident records of the organization which was responsible for the accident, regardless of aircraft or guided missile ownership. However, aircraft or guided missile damaged by non-USAF or unknown persons will be reportable by, and chargeable to, owning command.

Note 59—Indicate the number of days the aircraft or guided missile will be out of service, making your estimate in accordance with the following instructions:

(a) Air Force aircraft or guided missile "days out of service" will be the estimated total number of calendar days that the particular piece of equipment is out of service as a result of a ground accident, beginning with the day after the accident occurs and continuing up to, but not including, the day on which it is estimated that the aircraft will return to service.

(b) When aircraft or guided missile is destroyed beyond economical repair, a "days out of service" time will not be assigned.

(c) Aircraft or guided missile days out of service will be estimated at the time the accident occurs. This estimate will be based on information obtained from maintenance, supply, or other operational personnel and will reflect the time awaiting replacement parts, time awaiting repairs, actual repair time, and all other time preceding the return of the aircraft or guided missile to service.

(d) Aircraft or guided missile days out of service will be maintained on record as originally estimated at the time the report is prepared and forwarded. Discrepancies between the estimated and the actual days out of service will not be considered.

(e) If more than one aircraft or guided missile was involved in the accident, use additional tabs to describe the damage.

Note 60—Enter all USAF property damage as a result of the accident (other than vehicles and aircraft shown on lines 9, 10, and 11). Enter the name of the property damaged, such as "aircraft hangar," "aircraft hangar doors," "aircraft engine," "building," "generator," etc. Property damaged by non-USAF or unknown persons will be reportable by, and chargeable to, the owning command.

Note 61—Enter the repair cost, estimated in accordance with the procedures shown in Note 51. Aircraft and vehicle components which are not assembled to or installed in the aircraft or vehicle will be entered by name, such as "aircraft engine," or "aircraft wing assembly," "motor vehicle engine," and "aircraft power unit." Where one accident results in property damage losses to more than one major air command or to more than one installation within the same major air command, indicate and identify the separate costs for each. Do not use letters, abbreviations, or nicknames to describe type of property damaged.

VI.	NON-USAF INJURIES AND PROPERTY DAMAGE	
13	A. NO. DISABLING INJURIES — FATAL: Note 62; INJURED	B. PROPERTY DAMAGE (Type and extent): Note 63

FIGURE 7

Note 62—Indicate the number of disabling and fatal injuries sustained by non-Air Force persons (as defined in paragraph 4i) as a result of the accident.

Note 63—Briefly describe the type of non-USAF property damage and the extent of the damage. EXAMPLES: "Fence-damaged"; "House-damaged."

VII.	COMMENTS		
	GROUND SAFETY DIRECTOR		
14	A. SPECIFIC ACTION TAKEN TO PREVENT RECCURANCE: Note 64		
	B. SIGNATURE AND GRADE: Note 65	C. DATE REPORT COMPLETED AND FORWARDED: Note 66	
	SUPERVISOR		
15	COMMENTS: Note 67	SIGNATURE, GRADE, TITLE: Note 68	REVIEW DATE: Note 69
	REVIEWING OFFICER		
16	COMMENTS: Note 70	SIGNATURE, GRADE, TITLE: Note 71	REVIEW DATE: Note 72

FIGURE 8

Note 64—Indicate the specific action taken or recommended by the supervisor, reviewing officer, ground safety director, or other person as appropriate. Do not make an entry in this line until a thorough analysis of the accident situation and causes has been accomplished, and such materiel as AFM 32-3, Air Force Technical Orders, Air Force Regulations, National Safety Council Safe Practice Pamphlets, etc., have been referred to for technical assistance. The statement shown on this line should indicate the accomplishment of the basic objective of accident investigation, the prevention of similar accidents in the future. Any additional comments intended to clarify the report, justify its late submission, etc., should also be included.

Note 65—Show the typed name, military or civil service grade, and signature of the Ground Safety Director.

Note 66—Enter the date the report is completed and ready for forwarding to the next echelon of command.

Note 67—The supervisor immediately in charge of the Air Force operations to which the accident was incident will sign the AF Form 122, whether or not he concurs with the report. If he does not concur, he may attach a statement giving the reason for his nonconcurrence.

Note 68—Enter the typed name, grade, title and the signature of the supervisor.

Note 69—Enter the date that the supervisor reviewed the report.

Note 70—Enter the comments of the reviewing officer (may be the supervisor's immediate superior, the squadron commander, the wing commander, or the base commander). The reviewing officer should be a commissioned officer or a civilian of comparable grade.

Note 71—Enter the signature, grade, and title of the reviewing officer.

Note 72—Enter the date the reviewing officer reviewed the report.

14. Procedures for Forwarding AF Form 122, "Report of Ground Accident." The following procedures will apply:

a. *At installation level*—The ground safety director of an organization which is authorized to prepare AF Form 122, "Report of Ground Accident," will forward a complete original of the report to the Assistant for Ground Safety, Headquarters USAF, Washington 25, D. C., through normal channels. The report will be dispatched from the installation within five working days after the day of the accident. Copies of accident reports which include losses to other organizations will be forwarded as prescribed by paragraph 31 of this regulation.

b. *At Major Air Command level*—Reports of ground accidents will be accumulated by major air commands in the most expeditious manner possible. The number of copies transmitted from an installation will be as prescribed by the major air command. Weekly accumulations of reports at major air command headquarters will be forwarded to the Assistant for Ground Safety, Headquarters USAF, as a single transmission on the last work day of each week. All AF Forms 122 to be included for the report period will be forwarded by the major air command not later than the date on which the AF Form 122a is forwarded. These AF Forms 122 are due in Headquarters USAF on or before the 21st calendar day of the month following the report period.

SECTION C—AF FORM 122a, USAF GROUND ACCIDENT SUMMARY, RCS: 2-AF-X11

15. Instructions for Completing AF Form 122a, "Ground Accident Summary." Each major air command ground safety director will prepare an AF Form 122a, Ground Accident Summary, in accordance with the following instructions. The basic report period will be the calendar month. Major air commands will develop their own methods for maintaining the experience and exposure data required by this report. The AF Form 122a will include only a partial summary of the ground accident experience of the major air command and MATS units in a tenant status. It will be forwarded as a single transmission, and will be due in to the Assistant for Ground Safety, Headquarters USAF, on or before the 21st calendar day of the month following the report period.

GROUND ACCIDENT SUMMARY (Use reverse, if additional space is required)		MAJOR COMMAND	REPORTING PERIOD MONTH	REPORTING PERIOD YEAR
		Note 1		Note 2
SUMMARY				
		UNITS		
		ASSIGNED Note 3	MATS Note 4	
Note 5 MILITARY PERSONNEL	NON-DISABLING INJURIES	Note 6	Note 6	
	FATALITIES	Note 7		
	MAN-DAYS OF EXPOSURE	Note 8		
Note 9 CIVILIAN PERSONNEL	NON-DISABLING INJURIES	Note 10	Note 10	
	FATALITIES	Note 11		
	MAN-HOURS OF EXPOSURE	Note 12		
USAF MOTOR VEHICLE	MILEAGE	Note 13	Note 13	

FIGURE 9

Note 1—Major air command preparing the report.

Note 2—Calendar month and year for which report is being prepared.

Note 3—Ground accident tabulations which apply to personnel who are carried on a major air command's morning report as "assigned personnel."

Note 4—Ground accident tabulations which apply to personnel assigned to MATS units in a tenant status on an installation belonging to another major air command.

Note 5—Officers and airmen serving on extended active duty with the Air Force (this category also includes all persons of other United States military services).

Note 6—Total number of nondisabling injuries which military personnel sustained as a result of ground accidents during the report period.

Note 7—Total number of fatal injuries which military personnel sustained as a result of ground accidents during the report period.

Note 8—Total of the daily Air Force military personnel morning report strength figures for the report period.

Note 9—On-duty Air Force civilian personnel who are citizens and/or residents of the United States, its Territories, and Canada, who are employed by the Air Force and are paid from appropriated funds.

Note 10—Total number of nondisabling injuries which on-duty Air Force civilians sustained as a result of ground accidents during the report period.

Note 11—Total number of fatal injuries which on-duty Air Force civilians sustained as a result of ground accidents during the report period.

Note 12—Total payroll hours worked (including authorized legal holiday and overtime hours).

Note 13—Total number of miles which unit personnel have driven Air Force motor vehicles (on the property accounts of any Air Force organization) during the report period.

CANCELLED REPORT NUMBERS PREVIOUSLY ASSIGNED					
NUMBER	NUMBER REPLACED	REASON FOR CHANGE	NUMBER	NUMBER REPLACED	REASON FOR CHANGE
Note 14	Note 15	Note 16	Note 14	Note 15	Note 16

FIGURE 10

Note 14—This column is for numbers previously assigned to ground accident reports (AF Forms 122) but which are later cancelled completely or are replaced with new numbers.

Note 15—This column is for new numbers replacing cancelled numbers in first column.

Note 16—Give short (two or three word) statement explaining why the report number was cancelled or replaced.

REMARKS
Note 17
PREPARED BY: Note 18 — APPROVED BY: Note 19

AF FORM 15 DEC 53 122a PREVIOUS EDITIONS OF THIS FORM MAY BE USED.

FIGURE 11

Note 17—Give any additional information in this space that would serve to increase the value or clarity of this report. This section may also be used to furnish supplementary information. The reverse side of the form may be used for additional remarks.

Note 18—Name, rank, and title of person preparing this report.

Note 19—Signature, grade and title of the approving authority.

SECTION D—ANALYSIS PROCEDURES

16. Accident Indexes:

The accident indexes outlines in this section are established to facilitate the evaluation of ground accident losses. Major air commands may use any of these criteria at their discretion for evaluating their accident experience. Any of the indexes which are employed will be calculated following the methods outlined in this regulation. The basic report period will be the calendar month. All indexes for a given month (or period of several months) will reflect the accidents which were reported during the month (or period of several months).

17. Military Injury Rate. The military injury rate is the number of disabling injuries which Air Force military personnel sustain as a result of ground accidents for each 100,000 man-days of total exposure during the report period.

$$\text{Military Injury Rate} = \frac{\text{Number of Military Disabling Injuries} \times 100{,}000 \text{ Man-Days}}{\text{Total Military Man-Days of Exposure}}$$

a. The term "number of military disabling injuries" is the sum of all fatal, permanent total, permanent partial, and temporary total injuries which Air Force military personnel sustained during the report period (including both on-duty and off-duty disabling injuries). Non-disabling injuries are not included in this rate.

b. The total military exposure is the sum of the daily assigned military strength figures as shown on all morning reports for the entire report period.

18. Military On-duty Injury Rate. The military on-duty injury rate is the number of on-duty disabling injuries which Air Force military personnel sustain as a result of ground accidents for each 100,000 man-days of on-duty exposure during the report period.

$$\text{Military On-Duty Injury Rate} = \frac{\text{Number of On-duty Military Disabling Injuries} \times 100{,}000 \text{ Man-Days}}{\text{Total Military Man-Days of On-Duty Exposure}}$$

a. The term "number of on-duty military disabling injuries" is the sum of all fatal, permanent total, permanent partial, and temporary total injuries which on-duty Air Force military personnel sustained during the report period. The number of on-duty military disabling injuries will be the same as the number of injured Air Force military persons whose status, as reported on AF Form 122, was on-duty.

b. The term "on-duty exposure" is one-third of the sum of the daily morning report assigned military strength during the report period.

19. Military Off-Duty Injury Rate. Military off-duty injury rate is the number of off-duty disabling injuries which Air Force military personnel sustain as a result of ground accidents for each 100,000 man-days of off-duty exposure during the report period.

$$\text{Military Off-Duty Injury Rate} = \frac{\text{Number of Off-Duty Military Disabling Injuries} \times 100{,}000 \text{ Man-Days}}{\text{Total Military Man-Days of Off-Duty Exposure}}$$

a. The term "number of off-duty military disabling injuries" is the sum of all fatal, permanent total, permanent partial and temporary total injuries which off-duty Air Force military personnel sustained during the report period. The number of off-duty military disabling injuries will be the same as the number of injured Air Force military persons whose status, as reported on AF Form 122, was off-duty.

b. The term "off-duty exposure" is two-thirds of the sum of the daily morning report assigned military strength during the report period. For example, during a given month, 19 Air Force military persons from a given organization were reported as having sustained disabling injuries as a result of ground accidents. Of these 19 injuries, three occurred while the injured person was on-duty; the other 16 occurred while the injured person was off-duty. The 30 daily morning reports of assigned military strength add up to 410,103 man-days.

$$\text{Military Injury Rate} = \frac{19 \times 100{,}000}{410{,}103} = 4.63$$

$$\text{Military On-Duty Exposure} = 1/3 \times 410{,}103 = 136{,}701 = \text{Military On-Duty Injury Rate} = \frac{3 \times 100{,}000}{136{,}701} = 2.19$$

$$\text{Military Off-Duty Exposure} = 2/3 \times 410{,}103 = 273{,}402$$

$$\text{Military Off-Duty Injury Rate} = \frac{16 \times 100{,}000}{273{,}402} = 5.85$$

20. Military Fatality Rate. The military fatality rate is the number of fatal injuries which Air Force military personnel sustain as a result of ground accidents for each 100,000 man-days of exposure during the report period.

$$\text{Military Fatality Rate} = \frac{\text{No. of Military Fatal Injuries} \times 100{,}000 \text{ Man-Days}}{\text{Total Military Man-Days of Exposure}}$$

a. The number of military fatal injuries is the sum of all fatal injuries which Air Force military personnel sustained during the report period as a result of ground accident.

b. Total military man-days of exposure is the sum of the daily assigned Air Force military strength figures as shown on all morning reports for the entire report period.

21. Air Force Civilian Employee Injury Rate. Air Force civilian employee injury rate is the number of disabling injuries which on-duty Air Force civilian employees sustain as a result of ground accidents for each 1,000,000 man-hours of exposure during the report period.

$$\text{Air Force Civilian Employee Injury Rate} = \frac{\text{Number of on-duty Air Force Civilian Disabling Injuries} \times 1{,}000{,}000 \text{ Man-Hours}}{\text{Total Air Force Civilian Employee Hours of Exposure}}$$

a. The term "number of disabling injuries" is the sum of all fatal, permanent total, permanent partial, and temporary total injuries which on-duty Air Force civilian employees sustained during the report period as a result of ground accidents.

b. The term "total Air Force civilian employee hours of exposure" is the total payroll hours worked (including authorized legal holiday and overtime hours). For example, during a given month, 12 Air Force civilian employees sustain disabling injuries as a result of ground accidents on an Air Force installation. The total payroll hours worked by Air Force civilian employees on that installation during the month was 2,840,000 man-hours.

$$\text{Air Force Civilian Injury Rate} = \frac{12 \times 1{,}000{,}000 \text{ man-hours}}{2{,}840{,}000} = 4.23$$

c. Injuries sustained by non-USAF persons, MDAP personnel and foreign nationals will not be included in the Air Force civilian injury rates. The exposure of such persons will not be included in Air Force civilian exposure.

22. Civilian Fatality Rate. The civilian fatality rate is the number of fatal injuries which on-duty Air Force civilian personnel sustain as a result of ground accidents for each 1,000,000 man-hours of exposure during the report period.

$$\text{Civilian Fatality Rate} = \frac{\text{Number of On-Duty Air Force Civilian Fatal Injuries} \times 1{,}000{,}000 \text{ Man-Hours}}{\text{Total Air Force Civilian Employee Man-Hours of Exposure}}$$

a. The number of on-duty Air Force civilian fatal injuries is the sum of all fatal injuries which on-duty Air Force civilian employees sustained during the report period as a result of ground accidents.

b. Total Air Force civilian employee man-

hours of exposure is the total payroll hours worked (including authorized legal holiday and overtime hours).

23. Standard Injury and Fatality Costs. Standard injury and fatality costs used for evaluating the overall cost of Air Force ground accidents are illustrated in table 1.

a. Air Force personnel:

	Injury Classification				
	Non-disabling	*Temporary Total*	*Permanent Partial*	*Permanent Total*	*Fatal*
Air Force Military Person	$7	$30/day	$43,000	$63,500	$31,500
Air Force Civilian Person	$7	$14/day	$10,500	$70,000	$25,000

TABLE 1

b. *Foreign National Employees.* The estimated cost of injuries sustained by foreign national employees as a result of ground accidents will be developed by each major air command. These costs will be reported to Headquarters USAF semiannually as prescribed in Section E, paragraphs 35 and 36.

24. Ground Accident Cost Indexes. Ground accident cost indexes include the following costs per capita which relate accident costs to personnel strength:

a. Military injury cost per capita will be the total cost of all military injuries (including both non-disabling and disabling injuries) resulting from ground accidents divided by the average military strength during the report period.

$$\text{Military Injury Cost Per Capita} = \frac{\text{Total Cost of Military Injuries}}{\text{Average Military Strength}}$$

(1) The total cost of military injuries will be obtained by multiplying the number of each type of injury by the appropriate standard cost yardstick and totaling the products. The cost yardsticks are listed in paragraph 23.

(2) The average military strength is obtained by dividing the sum of the daily morning report military assigned strengths (present or absent) during the report period by the number of days in the report period. For example, the total cost of injuries to Air Force military persons resulting from ground accidents during November is $22,358. The sum of the 30 daily morning report assigned (present or absent) military strength is 159,700 man-days.

$$\text{Average Military Strength} = \frac{159{,}700}{30} = 5{,}323.33$$

$$\text{Military Injury Cost Per Capita} = \frac{\$22{,}358.00}{5{,}323} = \$4.20 \text{ per capita each month}$$

b. Civilian Injury cost per capita will be the total cost of all on-duty Air Force Civilian injuries (including both nondisabling and disabling injuries) resulting from ground accidents divided by the derived average civilian employee strength during the report period.

$$\text{Civilian Injury Cost Per Capita} = \frac{\text{Total Cost of Civilian Injuries}}{\text{Derived Civilian Employee Strength}}$$

(1) The total cost of civilian injuries will be developed by multiplying the number of each type of civilian injury by the appropriate standard cost yardstick and totaling the products. The cost yardsticks are listed in paragraph 23.

(2) The exposure and cost of injuries sustained by foreign nationals, MDAP personnel and non-USAF persons will not be included in this cost per capita calculation.

(3) The derived civilian employee strength will be developed by dividing the total civilian paid payroll man-hours worked (including authorized legal holiday and overtime hours) during the report period by the standard number of scheduled payroll work-hours during the report

period, including authorized holiday hours. The standard number of scheduled payroll work-hours during the report period will be the number of scheduled calendar days worked including authorized legal holidays) in the report period multiplied by eight. For example, a total of 1,229,700 Air Force civilian paid payroll man-hours worked (including paid legal holiday hours) during the month. There were 21 paid payroll work-days (including one paid legal holiday) in the month (30 calendar days minus 9 Saturdays and Sundays). Therefore, the standard number of work-hours in the month was 21 multiplied by 8, or 168 hours. The derived civilian strength is:

$$\text{Derived Civilian Strength} = \frac{\text{Total Civilian Man-Hours Worked}}{\text{Number of Standard Work-hours}} = 7320$$

and if the total cost of injuries to Air Force civilian employees as a result of ground accidents during the report period is $9,452, the cost per capita is:

$$\text{Civilian Injury Cost Per Capita} = \frac{\text{Total Injury Costs}}{\text{Derived Civilian Strength}} = \frac{\$9,452}{7,320} = \$1.29 \text{ per capita}$$

c. Total cost per capita will be the total cost of ground accidents divided by the total strength during the report period. The *total cost of ground accidents* will include military injury costs, Air Force civilian injury costs, and property damage costs. For example, assume that the examples in a and b above, (military injury costs and civilian injury costs) concern the same installation and that on this installation during the report period, reportable ground accidents caused $4,500 in Air Force property damage.

Cost of military injuries	$22,358
Cost of Air Force civilian injuries	9,452
Cost of property damage	4,500
Total ground accident costs	$36,310

Average military strength	5,323
Derived civilian strength	7,320
	12,643

$$\text{Total Cost Per Capita} = \frac{\text{Total Ground Accident Costs}}{\text{Total Strength}} = \frac{\$36,310}{12,653} = \$2.87 \text{ Per Capita Each Month}$$

d. *Each cost per capita index* (military injury cost per capita, civilian injury cost per capita, and total cost per capita) will always refer to the cost per capita for each report period, that is, for each calendar month. If annual per capita costs are employed, they will be identified as such and will be calculated as outlined in paragraph e below.

e. *Annual Costs Per Capita.* Costs per capita calculated on an annual basis will be identified by the words "Per Annum," for example, military injury cost per capita per annum; civilian injury cost per capita per annum and total cost per capita per annum. They will be calculated by dividing the total of all monthly strengths into the total of all monthly costs and multiplying the answer by 12. For example, the *total cost per capita per annum* at the end of May would be determined as illustrated in table 2.

	Total Accident Costs	*Average Monthly Strength*	*Monthly Cost Per Capita*
January	$ 5,740	3,417	$1.68
February	2,900	3,212	.90
March	10,690	2,967	3.60
April	4,600	3,045	1.51
May	6,700	3,055	2.19
	$30,630	15,696	X

$$\text{Total Cost} = \frac{\$30,630}{\text{Total Strength } 15,696} = \$1.95 \text{ (Average Cost Per Capita for 5 months)}$$

$$\text{Total Cost Per Capita Per Annum} = \text{Average Monthly Cost per Capita Multiplied by 12} = \$1.95 \times 12 = \$23.40$$

TABLE 2

Similar calculations may be made to obtain the *military or the civilian cost per capita per annum.*

25. Air Force Motor Vehicle Accident Rate. The Air Force motor vehicle accident rate is the total number of reportable Air Force motor vehicle accidents which occurred for each 100,000 miles of Air Force motor vehicle operation during the report period.

$$\text{Air Force Motor Vehicle Accident Rate} = \frac{\text{Number of Air Force Motor Vehicle Accidents} \times 100{,}000 \text{ miles}}{\text{Total miles of Air Force motor vehicle operation}}$$

a. The term "number of Air Force motor vehicle accidents" refers to the number of reportable Air Force motor vehicle accidents which were reported during the report period.

b. The term "miles of Air Force motor vehicle operation" is the total mileage that Air Force motor vehicles were operated during the report period. This mileage will be obtained from the installation motor pool officer. For example, during a given report period, Air Force motor vehicles were operated a total of 568,243 miles. There were seven reportable Air Force motor vehicle accidents during the same period.

$$\text{Air Force Motor Vehicle Accident Rate} = \frac{7 \times 100{,}000}{568{,}243} = 1.23$$

c. An Air Force motor vehicle accident will be included in the rate computation of any echelon of Air Force organization for which a rate is being calculated, according to the following procedures:

(1) If only one Air Force motor vehicle is involved, the accident will be included in the rate computation of the organization to which the driver of the Air Force motor vehicle is assigned, without regard to responsibility for the accident.

(2) If more than one Air Force motor vehicle is involved, but all drivers are assigned to the same organization, one accident will be included in the rate computation of the organization to which the drivers of the Air Force motor vehicles are assigned, without regard to responsibility for the accident.

(3) If more than one Air Force motor vehicle is involved, and the drivers are assigned to different organizations within the same major air command, one accident *and the property damage* incurred will be chargeable to the rate *and cost computations* of the organization to which the driver most responsible for the accident is assigned. The determination of responsibility will be in accordance with the procedures established by the appropriate major air command. Headquarters USAF will not determine responsibility for intra-command vehicle accidents.

(4) If more than one AF motor vehicle is involved in a reportable motor vehicle accident and the drivers are assigned to different major air commands, one accident and the property damage incurred will be chargeable to the rate and cost computations of the organization to which the driver most responsible for the accident is assigned. However, this does not affect in any way the provisions of paragraph 5a, Section A, concerning the chargeability of Air Force personnel injury losses, which are chargeable to the owning command without regard to whether the motor vehicle accident and property damage incurred is chargeable against that Command's accident rate and cost computations.

26. Private Motor Vehicle Accident Rate. The private motor vehicle accident rate is the total number of reportable private motor vehicle accidents which occurred for each 100,000 Air Force military personnel man-days of exposure during the report period.

$$\text{Private Motor Vehicle Accident Rate} = \frac{\text{Number of Reportable Private Motor Vehicle Accidents} \times 100{,}000 \text{ man-days}}{\text{Total Military Man-Days of Exposure}}$$

a. The number of reportable private motor vehicle accidents is the sum of all private motor vehicle accidents which were reported during the report period.

b. The total military man-days of exposure is the sum of the daily assigned Air Force military strength figures as shown on all morning reports for the entire report period.

SECTION E—JOINT TENANCY PROCEDURES

27. Definitions. For the purpose of this regulation, the following definitions will apply:

Tenant Organization—An Air Force organization, unit, or other activity which is occupying real property facilities which are under the jurisdiction of an organization other than the parent of the tenant organization.

Landlord Organization—The organization having primary jurisdiction over an Air Force installation where a tenant organization is based.

28. Preparation of Report of Ground Accident in the Case of Joint Tenancy. The following special instructions will apply:

a. The installation ground safety director will prepare, or insure the preparation of, reports on ground accidents involving tenant organizations on that installation. However, a tenant organization may be authorized to prepare its own ground accident reports if it has qualified ground safety personnel. In this event, the installation ground safety director will be notified immediately of the accident and furnished a copy of the completed "Report of Ground Accident," AF Form 122 (complete with signatures) for informational purposes.

b. Where one accident results in personal or property losses to more than one major air command or to more than one installation assigned to the same major air command, the appropriate commands or installations will be indicated on lines 7, 8, 9, 10, 11, and 12, of the AF Form 122.

c. Report numbers will be assigned by the tenant's parent installation or by the tenant itself as directed by the major air command to which the tenant organization is assigned.

d. A copy of each ground accident report involving tenant organizations should be maintained in the files of the installation ground safety office.

29. Forwarding Reports of Ground Accidents Involving Tenants. The tenant ground safety director will forward the original of the report to the Assistant for Ground Safety, Headquarters USAF, through the command channel of the tenant organization. The landlord organization will not forward a copy of the report to Headquarters USAF. The landlord organization will forward a copy of the report to its parent major air command if the major air command involved so directs.

30. Exposure and Experience for Tenants:

a. A tenant organization will report its exposure and experience data through its own command channel.

b. Procedures will be established at installations whereby the installation ground safety director will be notified of monthly tenant exposure including Air Force motor vehicle mileage driven, military strength, and civilian man-hours worked. The tenant's strength and mileage exposure will not be included in the landlord's exposure and mileage figures for cost or rate computations.

c. The Air Force motor vehicle mileage of a tenant organization will be all mileage driven by personnel assigned to the tenant. This will include miles driven in Air Force motor vehicles belonging to the landlord or to the tenant. The tenant Air Force motor vehicle mileage will not be included in the landlord Air Force motor vehicle mileage.

d. An Air Force motor vehicle accident and the property damage cost resulting from the accident will be charged against the tenant Air Force motor vehicle accident rate and property damage cost computations only if the Air Force motor vehicle driver most responsible for the accident was assigned to the tenant organization.

SECTION F—COURTESY REPORTING

31. Courtesy Reporting Procedures. Courtesy reporting procedures will be followed where ground accident losses of an installation are sustained, on or are first reported to, another installation.

a. The ground safety director of the installation on which the accident occurs or to which it is first reported, will prepare a "Report of Ground Accident," AF Form 122, as completely as possible.

b. When a reportable ground accident results in Air Force personnel injury or property losses to more than one major air command or to more than one installation assigned to the same major air command. The appropriate commands or installations sustaining the losses will be indicated on lines 7, 8, 9, 10, 11 and 12 of the AF Form 122.

(1) The ground safety director who prepared the courtesy report may sign the comments section.

(2) The installation ground safety director will forward a copy of the courtesy report to each organization which sustained a loss in the accident. The words "Courtesy Copy" will be placed in the top margin of these copies.

(3) Report numbers will not be assigned to courtesy reports which are forwarded to the organizations which experienced the losses.

(4) Ground safety directors of each organization which sustained a loss will complete a report on the accident, based on the information contained in the courtesy report.

(a) The report will then be numbered as prescribed in paragraphs 9 and 13 (Note 5), Section B.

(b) Each complete report, based on the courtesy information, will be signed by the ground safety director.

(c) The original of each completed report will be forwarded to the Assistant for Ground Safety, Headquarters USAF, through channels.

SECTION G—PROCEDURES FOR MILITARY PERSONS ON TEMPORARY DUTY, PASS, LEAVE, FURLOUGH, PERMANENT CHANGE OF STATION, OR ABSENT WITHOUT LEAVE

32. Temporary Duty, Pass, Leave, Furlough, and Permanent Change of Station. The courtesy reporting procedures outlined in paragraph 31, Section F will be followed when an Air Force military person on temporary duty, pass, leave, furlough, or permanent change of station is injured away from the base to which he is assigned or is the person most responsible for damage to Air Force property. The injuries will be included in the accident index computations of the commands sustaining the loss. The injuries will not be included in the index computations of the organization preparing the courtesy report. In accidents involving personnel *on a permanent change of station between two major air commands*, the organization within the major air command carrying the injured person on its morning report will complete a report on the accident. The accident and the injury will not be chargeable to the rate and cost computations of the organization and/or major air command carrying the injured person on its morning report. Headquarters USAF will include these accidents and injuries in the overall accident experience of the Air Force.

33. Air Force Military Persons Absent Without Leave. Reportable accidents which occur to Air Force military persons who are in absent without leave status will be reported if the person involved was carried on the morning report of an Air Force organization at the time of the accident. If the person has been dropped from the organization's morning report, the accident need not be reported.

SECTION H—INJURIES AND/OR PROPERTY DAMAGE INVOLVING OTHER UNITED STATES GOVERNMENT AGENCIES

34. Personnel or Equipment from a United States Government Agency Other Than the Air Force. If such personnel are involved in an accident which occurs on, or is first reported to, an Air Force installation, the installation ground safety director will prepare a "Report of Ground Accident," AF Form 122, on the accident unless the Government agency concerned has procedures for reporting its own accidents. The report will not be numbered.

The original and one copy will be forwarded to the Assistant for Ground Safety, Headquarters USAF, through channels. The Assistant for Ground Safety will forward the copy to the appropriate Government agency.

SECTION I—FOREIGN NATIONALS AND MUTUAL DEFENSE ASSISTANCE PACT (MDAP) PERSONNEL

35. Individual Injuries to Foreign National Employees and MDAP Personnel. Individual injuries to foreign national employees and MDAP personnel will not be reported to the Assistant for Ground Safety, Headquarters USAF. Instead, records will be kept of the numbers of fatalities, permanent total, permanent partial, temporary total, and nondisabling injuries suffered by each type of person as a result of ground accidents. Major air commands will establish suitable procedures for maintaining these records. However, nothing in these reporting instructions will be interpreted as changing the policy stated in AFR 32–1, that is "the scope of the Air Force ground safety program includes all injury to personnel and damage to materiel incident to Air Force ground operations." Each major air command will conduct accident prevention programs for foreign national employees and MDAP personnel.

36. Summary of Foreign National and MDAP Injury Experience. A summary of the foreign national and MDAP injury experience will be forwarded semiannually (as of the end of June and December) from each major air command concerned to the Assistant for Ground Safety, Headquarters USAF.

37. Foreign National and MDAP Injuries. Foreign national and MDAP injuries and their

resulting costs will not be included in computing the disabling injury rates and cost indexes, respectively. Similarly, the foreign national and MDAP exposure and strength will not be included in computing exposure and strength.

38. Security Classification. Classification of reports required by this regulation will be in accordance with AFR 205–1.

39. Supply of Forms. Forms prescribed by this regulation will be available on or about 1 June 1956 and will be requisitioned through supply channels.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

DISTRIBUTION:
S

CHANGE

AIR FORCE REGULATION NO. 32-2A

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *30 AUGUST 1956*

GROUND SAFETY

Ground Accident Reporting and Analysis System

AFR 32-2, 18 April 1956, is changed as follows:

* * * *

13. Specific Instructions for Filling Out AF Form 122. This paragraph gives the specific information required in filling out AF Form 122 correctly. In the illustrations, which depict a part of the report, there will be numbered "Notes" referring to specific blocks or spaces of the report. These notes are keyed to the report to give, in the simplest form possible, a complete explanation of the material to be put into the report.

* * * *

Note 16—The following instructions are issued for accidents involving USAF and private motor vehicles equipped with restraining devices, such as seat belts, etc.:

a. If an accident occurs which involves a USAF or private motor vehicle equipped with restraining devices, insert "Yes" in Section III, line 6, block A, AF Form 122, and

b. Report the following specific information in an attachment to AF Form 122:

(1) Number and location of restraining devices.
(2) Method of anchoring restraining devices.
(3) Number and location of restraining devices in use at time of accident.
(4) Number of persons restrained by each restraining device.
(5) Name of the manufacturer of the restraining device.
(6) Material used in restraining device—i.e., nylon, cotton, etc.
(7) Did restraining device have shoulder strap attachment? If yes, was it used at time of accident?
(8) Did restraining device fail in anyway? If *yes*, explain.
(9) Did person using restraining device have any difficulty getting free after the accident?
(10) In your opinion, or in the opinion of the occupant of the vehicle, did the restraining device prevent or decrease severity of injury? Please identify opinions.

* * * *

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

DISTRIBUTION:
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AIR FORCE REGULATION NO. 32-5

DEPARTMENT OF THE AIR FORCE
WASHINGTON, 3 AUGUST 1956

GROUND SAFETY

Tokyo Raiders—USAF Traffic Safety Award

	Paragraph
Purpose	1
Policy	2
Type of Award	3
Possession and Award Periods	4
Eligibility	5
Basis for Award	6
Responsibility for Administration	7
Command Participation	8

1. Purpose. This regulation prescribes the policy for the selection and awarding of the Tokyo Raiders—USAF Traffic Safety trophy.

2. Policy. The importance of the prevention of vehicle accidents to the economy and effectiveness of the Air Force has led to the acceptance of the Tokyo Raiders—USAF Traffic Safety trophy, as recognition for outstanding accomplishment in the reduction of vehicle accident losses involving Air Force personnel and equipment.

3. Type of Award. The trophy is a large bronze cup, encompassed with symbolic winged wheels, capped with a spread winged eagle. The inscription on the cup reads "United States Air Force Traffic Safety Trophy Awarded for Vehicle Accident Prevention." A large band of shields on the bronze base provide space for engraving the names of annual winners on this rotating type of award.

4. Possession and Award Periods. The trophy will be presented annually on a rotational basis by the Tokyo Raiders, the sponsoring organization composed of members of the famous World War II Tokyo mission led by General Doolittle. The competition period for the award will extend through each calendar year. Each year a major air command will be selected to receive the award based upon comparative vehicle accident records and prevention programs, and will retain possession of the award until next year's winner is determined.

5. Eligibility. Major air commands considered eligible for competition will be those having three or more operating bases in the ZI during the award period. Commands having both ZI and oversea bases will compete on the basis of ZI exposure and experience only.

6. Basis for Award. In the evaluation and comparison of major air command vehicle accident prevention efforts, the following adjusted factors will be used to determine the trophy winner:

a. Accident rate for Air Force-owned vehicles.

b. Cost rate of Air Force-owned vehicle accidents.

c. Private vehicle injury and fatality rates.

d. Cost rate of private vehicle accidents per capita (military).

e. Outstanding accomplishments in the promotion of traffic safety programs.

7. Responsibility for Administration. The USAF Traffic Committee, Headquarters USAF, will be responsible for the selection of the trophy winner. The USAF Traffic Committee is composed of representatives of staff agencies having a vested responsibility for vehicle accident prevention, i. e., representatives of the Air Provost Marshal; the Director of Transportation; the Surgeon General, USAF; Assistant Chief of Staff, Installations; and Assistant for Ground Safety. The Office of the Assistant for Ground Safety will be responsible for the collection and preparation of the necessary data submitted by major air commands upon which the selection will be evaluated. The trophy will be presented by the Tokyo Raiders organization at their annual meeting. Notification of the command selected will be made by Headquarters USAF. The award should be prominently displayed by the winning organization to assure the greatest degree of public interest. Publicity concerning this event will be the responsibility of the Office of Information Services assisted by the USAF Traffic Committee.

8. Command Participation. To assist the

USAF Traffic Committee in the selection of the trophy recipients, each eligible major air command will maintain a brief résumé of the highlights of its traffic accident prevention program. This information will be requested, as required, to aid in the determination of the trophy winner.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

DISTRIBUTION:
M (minus overseas)

AIR FORCE REGULATION NO. 32-8

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *16 AUGUST 1956*

GROUND SAFETY

Uniform Motor Vehicle Traffic Control Devices for Streets and Highways

PURPOSE: This regulation authorizes the use of uniform motor vehicle traffic control and regulatory devices for streets and highways at Air Force installations in the continental United States and Alaska.

1. What Traffic Control Devices Include and How They Will Be Designed. Traffic control devices include the signs, signals, markings, and related appliances employed to safeguard, regulate, warn, and guide motor vehicle traffic. The devices will be designed and installed in such a manner that they will be recognized and understood at a glance. Uniformity and simplicity in design are most important in aiding recognition, and the standard application of each device is necessary to insure optimum traffic control. When these principles are not observed, funds may be wasted and ineffective measures and confusion will result.

2. Standards To Be Used. To insure the use of uniform traffic control and regulatory devices on Air Force installations, use only devices and related appliances which meet the appropriate design standards in the State or Territory in which the installation is located. In a State which does not have design standards for traffic control devices, the devices used on an Air Force installation will conform to the "Manual on Uniform Traffic Control Devices for Streets and Highways," August 1948, as revised September 1954. The manual is approved as American Standard D6.1–1948, American Standards Association, and may be procured in accordance with AFR 70–16 from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Wherever possible, traffic control devices on Air Force installations will conform to the requirements established in the manual.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

DISTRIBUTION:

B (minus overseas and miscellaneous); X:
Alaskan Air Command ---------- 100
Air National Guard units (unit–1; adviser–1) ---------- 2

*This regulation supersedes AFR 32–8, 12 January 1954.

AIR FORCE REGULATION NO. 32-11

DEPARTMENT OF THE AIR FORCE
WASHINGTON, 26 MAY 1964

GROUND SAFETY

Safe Driver Award—AF Form 192

	Paragraph
Purpose and Scope	1
Personnel Eligible	2
General Criteria	3
Specific Criteria	4
Awarding Authority	5
Supply of Forms	6

1. Purpose and Scope. This Regulation prescribes the criteria for the award of AF Form 192, "Safe Driver Award," which will be used to recognize meritorious safe driving records of Air Force motor vehicle operators. This Regulation applies to all Air Force activities to and including base level.

2. Personnel Eligible. All military and civilian personnel (including foreign nationals) whose principal job is the operation of an Air Force motor vehicle will be eligible in accordance with paragraph 3a. All military and civilian personnel (including foreign nationals) engaged in duties which require the operation of an Air Force motor vehicle as an incidental duty will be eligible in accordance with paragraph 3b. Responsible personnel should exercise care to certify only those vehicle operators who, in their judgment, are rightly entitled to such award, especially if low mileage is involved. The presentation of an award to a vehicle operator with extremely low mileage will lessen the value of similar recognition accorded to vehicle operators who have driven considerable distances.

3. General Criteria:

a. *Personnel Regularly Assigned or Employed as Motor Vehicle Operator.* Military and civilian personnel regularly assigned or employed as a motor vehicle operator may qualify by:

(1) Holding a valid current DD Form 313, "U. S. Government Operator's Permit" (formerly WD AGO 9–74 which may be used).

(2) Performing duty as a driver of Air Force vehicles without traffic violations and without being held wholly or partially responsible for an Air Force motor vehicle accident during the period for which the award is given.

(3) Having the following efficiency rating for that period:

(a) *Military Personnel*—Excellent or better.

(b) *Civilian Personnel*—Satisfactory or better.

b. *Personnel Operating Motor Vehicle as Incidental Duty.* Military and civilian personnel engaged in duties which require the operation of an Air Force motor vehicle as an incidental duty may qualify by:

(1) Holding a valid DD Form 313.

(2) Operating an Air Force vehicle without traffic violations and without being held wholly or partially responsible for an Air Force motor vehicle accident during the period for which the award is given.

(3) Having the following efficiency rating for that period:

(a) *Military Personnel*—Excellent or better.

(b) *Civilian Personnel*—Satisfactory or better.

(4) Driving at least 5,000 miles for each consecutive 12-month period.

4. Specific Criteria:

a. *One-Year Award.* When a vehicle operator has completed 12 consecutive months of duty in accordance with paragraphs 2 and 3, he will be eligible for the 1-year award.

b. *Two-Year Award.* When a vehicle operator has completed 24 consecutive months of duty in accordance with paragraphs 2 and 3, he will be eligible for the 2-year award.

c. *Three-Year Award.* When a vehicle operator has completed 36 consecutive months of duty in accordance with paragraphs 2 and 3, he will be eligible for the 3-year award.

d. *Five-Year Award.* A vehicle operator is eligible for the 5-year award when he has com-

*This Regulation supersedes AFR 32–11, 9 October 1950, including Change 32–11A, 5 February 1951.

pleted 60 consecutive months of duty in accordance with paragraphs 2 and 3.

e. *Ten-Year Award.* A vehicle operator is eligible for the 10-year award when he has completed 120 consecutive months of duty in accordance with paragraphs 2 and 3.

5. Awarding Authority. Base commanders or comparable authority should make the award. Award recommendation should be submitted jointly by the motor transport officer and ground safety officer.

6. Supply of Forms. AF Form 192 will be requisitioned through supply channels.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

K. E. THIEBAUD
Colonel, USAF
Air Adjutant General

DISTRIBUTION:
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AIR FORCE REGULATION NO. 32-13

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *16 NOVEMBER 1953*

GROUND SAFETY

Marching Units and Pedestrian Safety

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1. Purpose and Scope. This Regulation prescribes the minimum policies and procedures to safeguard personnel movements, either as units or individuals, on roads or thoroughfares of Air Force installations and at the same time to permit an expeditious flow of vehicular traffic. This Regulation applies to all Air Force activities down to and including base level.

2. Policy:

a. Commanders of Air Force installations will insure the safe conduct of marching units and pedestrian traffic within installation boundaries. Necessary local directives to effect the safe control of such traffic will be published.

b. Coordination with local civil agencies having jurisdiction over routes of travel to be used by marching troops off-base will be accomplished prior to such movements. In the absence of established marching unit safety criteria by local authority for off-base movements, this Regulation will govern.

3. Minimum Procedures To Be Followed by Marching Units:

a. The movement of marching units will normally be conducted on the right side of the roadway in the direction of the flow of motor vehicle traffic.

b. A minimum of two individuals of the marching unit, under the supervision of the unit commander, will be appointed as road guards to perform the following functions:

(1) One individual to be at an appropriate distance to the front and one individual to the rear of a marching unit so that motor vehicle traffic can be controlled and to provide warnings if traffic is producing a hazard to the unit.

(2) Control motor vehicle traffic while a unit is passing through a roadway intersection.

4. Warning Devices. Appropriate signal devices and articles of wearing apparel which are clearly visible and understandable to motor vehicle operators, should be furnished to unit road guards during periods of darkness and reduced visibility.

5. Pedestrian Movement Procedures. Pedestrians (personnel walking on, across, or parallel to a roadway or street, and not in a military formation) will be required to use sidewalks, safety zones, and so forth, where provided. Pedestrian movements, on roadways where provisions are not made for their safety, will be conducted on the left side facing oncoming traffic and not more than two abreast.

6. Motor Vehicle Conduct. Motor vehicle traffic will yield the right-of-way to marching units and pedestrians who are in prescribed pedestrian travel zones. Normal motor vehicle traffic may be permitted to proceed around marching units at the discretion of the unit commander and at a speed not to exceed 15 miles an hour. Unit commanders will yield the right-of-way to emergency vehicles when operated as such. Emergency vehicles will proceed at a reasonably safe speed in the area of congestion.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

K. E. THIEBAUD
Colonel, USAF
Air Adjutant General

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AIR FORCE REGULATION
NO. 33-16

DEPARTMENT OF THE AIR FORCE
WASHINGTON, 3 MAY 1955

GROUND SAFETY

Ground Safety Briefing Prior to Change of Station

	Paragraph
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Background Information	2
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1. Purpose and Scope. This Regulation sets up the policy and responsibility for briefing members of the Air Force on ground safety prior to change of station. It also gives commanders certain points to stress in this briefing.

2. Background Information. Each year an undue manpower loss is sustained through injuries and deaths of members of the Air Force while en route between duty stations. In addition to the human suffering, these losses cause unnecessary replacement and administrative workload problems. Most of these losses are a direct result of driving private vehicles at excessive speed, while fatigued, or in a reckless manner over unfamiliar roads.

3. Responsibility for Briefing. Commanders preparing persons for movement from home base to new duty stations, ZI or overseas, will make sure that each person is briefed on personal safety while on leave or travel status prior to his departure. The individual who conducts the briefing will emphasize the problems concerned with the selected mode of travel. Whenever privately owned vehicles are to be used, a person should be encouraged to use available services offering current highway information, route planning, weather forecasts, and road maps.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

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AIR FORCE REGULATION NO. 32-17

DEPARTMENT OF THE AIR FORCE
WASHINGTON, 21 JUNE 1967

GROUND SAFETY

Private Vehicle Driver Education Program

PURPOSE: This regulation prescribes a compulsory driver improvement course for all airmen under 25 years of age and recommends remedial driver training for traffic violators and basic driver training for beginning drivers.

1. Why Driver Education Is Necessary. Each year more than 600 members of the Air Force are killed and about 5,500 injured as the result of accidents in private motor vehicles. These losses deplete vital manpower resources, drain millions of dollars from the Government annually in hospitalization and death costs, and cause untold human suffering. Most of these accidents result from personal deficiencies in the driver. Since it has been demonstrated that many of these deficiencies can be corrected and accidents prevented through proper education of drivers, a driver education program is established.

2. Objective of the Driver Education Program. The objective of the driver education program is to improve driver habits and behavior, to:

a. Reduce injury and death to Air Force personnel from private vehicle accidents,

b. Decrease attendant personnel losses and costs,

c. Further the well-being of all personnel, and

d. Increase the prestige of the Air Force through improved relations with the public.

3. Who Is Responsible for Driver Education. All commanders have an inherent responsibility for the safety and welfare of Air Force personnel. Therefore, each commander will insure that the provisions of this regulation are appropriately implemented. The education and training measures contained herein will be applied in conjunction with applicable provisions of AFR 32-7 and AFR 125-14, to insure that a comprehensive vehicle accident prevention program is in effect.

4. Preventing Accidents. Private vehicle accidents can be prevented through effective education and control of drivers. Desirable knowledge, habits, skills, and attitudes will be fostered through the prescribed and approved educational measures established in the following paragraphs, to guide and assist Air Force personnel in operating their private vehicles safely on the public streets and highways.

5. Compulsory Driver Improvement Course. Airmen under 25 years of age represent the largest share of the Air Force driving population. Like their civilian counterparts, these drivers have a higher motor vehicle accident rate than any other group. Accordingly, all airmen who are under the age of 25, with the exception of those who may be exempted under g below, will be given a driver improvement course based on the following standards:

a. *Course Description.* The course will consist of 10 hours of classroom instruction conforming to the course outline provided in attachment 1. Course content should be modified, where necessary, to emphasize local accident problems and conditions.

b. *When Conducted and By Whom Administered.* Normally, the course will be conducted at installation level for assigned personnel and will include accommodation for personnel of tenant units. Personnel on initial enlistment will be given the course at their first permanent duty station. The course should be administered through the base Ground Safety activity with Provost Marshal, Judge Advocate, and other activities, as well as the local police, providing support in subjects relating to their specialties. Transportation facilities, including class rooms, psychophysical testing devices and visual aids, should be used where these can be made available by the Transportation officer.

c. *Class Size.* Where practicable, classes should be limited to 25 students, to further student participation and discussion.

d. *Supporting Materials.* Suitable study and reference materials will be provided students. These materials should be obtained through normal sources for traffic safety materials, including free distributions made by public and private agencies with traffic safety interests. Supplementary materials may be pre-

pared locally. Attachment 2 lists recommended reference materials.

e. *Record of Course Completion.* A statement attesting to the date and location of completion of the course will be prepared and filed in section 1 of the unit personnel records of each individual who successfully completes the course. Newly assigned airmen under 25 years of age who cannot present this evidence of completion will be required to take the course at the installation of assignment.

f. *Funding.* All expenditures of funds and other resources made for this course will be absorbed within normally authorized base operating resources; no increase in funds or spaces will be generated thereby.

g. *Drivers Who May Be Exempted.* Commanders may exempt from the compulsory course those airmen under age 25 who meet the following requirements:

(1) Present satisfactory evidence of having completed the basic driver training course described in paragraph 7;

(2) Show proof of satisfactory completion of an accredited nonmilitary driver training course.

6. Remedial Driver Training. AFR 125–14 requires that Provost Marshals establish procedures for obtaining reports of off-base traffic violations and accidents involving Air Force personnel. Pertinent information contained in these reports will be recorded on AF Form 1313, Driver Record. This individual driver record will permit the identification of drivers most in need of remedial training. It is recommended that base commanders establish remedial drivers schools to instruct and correct these problem drivers.

a. *Course Description.* The course should provide from 5 to 10 hours of classroom instruction on local traffic laws, accident causes, preventive action, and other appropriate subjects. Attachment 1 may be used as a guide to course content. This school should normally be administered by the Provost Marshal with the assistance of Ground Safety and other interested activities.

b. *Command Option.* While the compulsory driver improvement course prescribed in paragraph 5 is being conducted at an installation, the commander should require problem drivers, regardless of age, to attend this course in lieu of conducting a separate remedial driver training course.

c. *Funding.* All expenditures of funds and other resources made for this course will be absorbed within normally authorized base operating resources; no increase in funds or spaces will be generated thereby.

7. Basic Driver Training. Evidence has shown that individuals who learn to drive in an approved course under qualified instructors have driving records far superior to those who are untrained. Beginning Air Force drivers should be provided an opportunity for such training. It is recommended that installations offer basic driver training for beginning drivers as an education service activity, in accordance with AFR 34–8.

a. *Course Description.* The course recommended consists of 30 hours of classroom instruction and 8 hours behind the wheel of a dual-control motor vehicle. Course content and standards will conform to those established by the American Automobile Association and State educational agencies. The number of hours of classroom and behind-the-wheel instruction may be reduced for drivers of some experience who are taking the course as a refresher. Assistance in establishing these courses may be obtained through local automobile clubs affiliated with the American Automobile Association. Courses may be contracted for in accordance with AFR 34–8, or instructors hired from local high schools or driver training schools.

b. *Obtaining Training Vehicles.* Dual-control training vehicles for the behind-the-wheel portion of the training may be obtained as a part of the contract let with local high school or other qualified instructors. Where other arrangements are necessary, the following procedures may be adopted:

(1) *Provided by Local Automobile Dealers.* In many areas, local automobile dealers will offer a dual-control training vehicle at a token fee as a public service. These vehicles may be leased or rented with nonappropriated funds when the commander considers this action to be in the interests of the well-being of personnel. In this instance, suitable liability insurance must be purchased protecting the interests of the Air Force as a third party. The American Automobile Association and affiliated clubs will provide assistance in obtaining dual-control vehicles.

(2) *Modified Government Vehicles.* Where vehicles cannot be obtained by the means described above, dual controls

may be installed on Government vehicles, provided that:

(a) The cost of installation does not exceed $100;

(b) The dual controls do not interfere with the normal use of the vehicle; and

(c) No additional requirements for vehicles will be generated thereby.

c. *Funding.* Contracts for instructors and the local purchase of materials and equipment for the effective operation of the voluntary basic driver training classes may be accomplished in accordance with AFR 34–8.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

J. L. TARR
Colonel, USAF
Air Adjutant General

2 Attachments:
1. Course Outline—USAF Compulsory Driver Improvement Course.
2. References.

DISTRIBUTION:
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COURSE OUTLINE
USAF COMPULSORY DRIVER IMPROVEMENT COURSE

(Supplement instruction with films, traffic boards, demonstrations and other audio-visual aids, where appropriate.)

FIRST HOUR

(Objective: To describe the social and economic importance of the automobile, emphasize the necessity for traffic control and accident prevention in the public interest, and orient the driver to the course and its purpose.)

1. The Place of the Automobile in the World of Today.

a. Development and influence of the automobile.

(1) Changes in style, power, speed, and other features over the past 50 years.
(2) Economic and social dependence on motor vehicles in the present day.
(3) Control of over 60 million automobiles and their drivers essential to avoid chaos.

b. Automobile accidents not a necessary evil.

(1) More people injured and killed by automobiles in the U. S. than in all the country's wars.
(2) The cost in deaths, injuries, lost pay, damaged property, court punishment, fines, pain, and suffering.
(3) Staggering losses in the Air Force alone.

c. President of the U. S., State Governors, the Secretary of Defense, Chief of Staff, USAF, and other leaders are seriously concerned.

(1) National traffic safety programs conducted to reduce accidents.
(2) More stringent laws and law enforcement being applied.
(3) Additional safety features being built into new cars, such as seat belts, padded dash panels, etc.

d. This course is intended to help the Air Force driver understand his personal limitations and capabilities and his responsibilities as a member of the driving public.

SECOND HOUR:

(Objective: To identify certain permanent and temporary physical characteristics of the driver and show that physical deficiencies must be compensated for by exercising common sense and self-control.)

2. Physical Fitness of the Driver (driver evaluator and other psychophysical testing devices may be used to make sample measurements of physical qualities).

a. Physical fitness important in good driving performance.

(1) Vision affects driving: visual acuity, depth perception, field of vision, night vision, glare recovery, and color vision.
(2) Reaction time affects driving.
(3) Physical coordination and control affect driving.
(4) Deficiencies in these areas can be identified and compensated for by good judgment.

b. Young drivers have best physical fitness and highest skill.

(1) Despite this they are poorest drivers because they lack judgment.
(2) Physical deficiencies more than compensated for by extra care on part of older drivers.
(3) Physical fitness and skill of the young driver cannot begin to compensate for lack of maturity and judgment. It's a question of mind over matter.

c. Certain temporary physical limitations seriously impair driving.

(1) Use of alcohol: affects senses, inhibitions, judgment.
(2) Fatigue: falling asleep at the wheel, slow reflexes, lack of alertness, attention.
(3) Illness; drugs.

THIRD HOUR:

(Objective: To show that the driver's mental outlook is the most important single factor relating to safe driving and that faulty mental attitude causes more accidents than all other things combined.)

3. Mental Fitness of the Driver Is Most Important.

a. Bad risks as drivers.

(1) The show-off.
(2) The egotist.
(3) The rationalizer.
(4) The thwarted or frustrated.
(5) The wise guy.

(6) The hot-tempered.
(7) "Chicken" players and other varieties of eight-balls.

b. Make-up of a top-notch driver.
(1) Alertness.
(2) Attention.
(3) Knowledge.
(4) Good habits.
(5) Courtesy.
(6) Defensiveness.
(7) Maturity.
(8) Judgment.
(9) Sportsmanship.

c. Are you a bad risk or a top-notch driver? —Group discussion and self-analysis.

FOURTH HOUR:

(Objective: To show that the laws of nature which govern the motion of a motor vehicle must be considered at all times and cannot be violated without serious consequences.)

4. Traffic Laws Made by Nature Affect Driving.

a. Nature's laws apply to all drivers alike; are unyielding and self-enforcing.
(1) Friction between tires and road.
(2) Centrifugal force on curves.
(3) Kinetic energy of motion.
(4) Force of impact.
(5) Gravity force downgrade.

b. Stopping distances and the driver. (Brake detonator stopping distance demonstration to support discussion.)
(1) Qualities of the driver affect stopping distance: alertness, perception, judgment, reaction.
(2) Physical factors of the vehicle and roadway affect stopping distance: brakes, tires, speed, friction, grade.
(3) Other conditions affecting stopping: rain, snow, ice.

c. The driver can compensate for all of these conditions.

FIFTH HOUR:

(Objective: To familiarize drivers with basic traffic laws and encourage their observance.)

5. Man-Made Laws Relating to Driving (conforming to State and local laws and regulations applicable in the ZI or overseas location of the installation).

a. Laws have developed for your protection.
(1) Congestion, chaos, and conflict without laws.
(2) Violation of laws antisocial.
(3) Voluntary compliance is the key to control.

b. Driving is a privilege, not a right; certain requirements must be met.
(1) Operator's license.
(2) Vehicle registration.
(3) Financial responsibility.

c. Rules of the road must be observed.
(1) Keep to right.
(2) Passing.
(3) Signal before turning.
(4) Reasonable and prudent speed.
(5) Allow overtaking vehicle to pass.
(6) Yield right-of-way at unmarked intersections.
(7) Other.

d. Signs governing driving.
(1) Stop sign.
(2) Yield sign.
(3) Warning sign.
(4) Regulatory sign.
(5) Information sign.

e. Traffic signals.
(1) Red light.
(2) Yellow light.
(3) Green light.
(4) Flashing red light.
(5) Flashing yellow light.
(6) Arrows.

f. Pavement markings.
(1) Solid lines.
(2) Broken lines.
(3) Turn lines.
(4) Crosswalk and stop lines.

SIXTH HOUR:

(Objective: To familiarize drivers with good driving practices and habits and the importance of hazard anticipation and perception, and to encourage the development of these qualities.)

6. Traffic Practices of the Good Driver.

a. City driving, urban and suburban: what to do, hazards to look for.
(1) Entering traffic stream.
(2) Changing lanes.
(3) Turning movements.
(4) Intersections.
(5) Pedestrians.
(6) Other.

b. Highway and super-highway driving: what to do, hazards to look for.
(1) Speed control.
(2) Control on curves.
(3) Passing techniques.

(4) Following distances.
(5) Merging.
(6) Exit roads.
(7) Highway hypnosis.

c. Driving on pass, leave, TDY, or PCS.
(1) Planning the trip.
(2) Allowing adequate time.
(3) Observing laws.
(4) Compensating for weather, road, and other conditions.
(5) Wiring base for extension in the event time allowed might be exceeded. Time cannot be made up by speeding.

SEVENTH HOUR:

(Objective: To provide the driver with information relating to and an understanding of the allowances necessary when driving under adverse conditions.)

7. Driving Under Unfavorable Conditions.
a. Driving at night—slow down.
(1) Overdriving headlights.
(2) Approaching curves.
(3) General reduction in visibility.
(4) Headlight glare.
(5) Pedestrians.
(6) Fatigue.
(7) Use of intoxicants.

b. Driving on ice and snow.
(1) Effect on traction and stopping distance.
(2) Skid recovery.
(3) Windshield.
(4) Blind spots.
(5) Reduce speed—allow more travel time.
(6) Other.

c. Other hazards.
(1) Mountain driving.
(2) Carbon monoxide.
(3) Heavy traffic.
(4) Vehicle break-down: getting off the road.

EIGHTH HOUR:

(Objective: To define and summarize the driver's responsibilities to himself and others.)

8. You, the Driver.
a. Legal responsibilities.
(1) Compliance with law.
(2) Action in the event of an accident.

b. Responsibilities to family.
(1) Personal safety.
(2) Income.
(3) Freedom from worry and suffering.

c. Responsibilities to community.
(1) Useful citizen.
(2) Consideration for property and lives of others.

d. Responsibilities to Air Force and country.
(1) Prestige of Air Force; public relations.
(2) Availability for duty.

NINTH HOUR:

(Objective: To stimulate the thinking of each driver on previous instruction and encourage personal application of this information in an actual accident situation.)

9. Case Study: Select a suitable automobile accident, from available reports, for detailed group analysis and study.

a. Reconstruct the accident.

b. List and analyze all causes of the accident through class participation and discussion.

c. List and analyze all preventive action which could have been taken, through class participation and discussion.

TENTH HOUR:

(Objective: To measure how well important phases of the course have been absorbed by drivers and to screen out for further attention those who are still unprepared to drive.)

10. Written test (test to be designed, administered, and scored locally). Cover important materials presented during the previous 9 hours, with emphasis on material relating to driving attitude and driving judgment.

REFERENCES

Unless otherwise indicated, the following publications will be procured locally:

1. *Accident Facts.* National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. Annual publication. 96 pp. 75¢.
2. *Accident Prevention Handbook for Air Force Personnel,* AFM 32-3, Headquarters USAF, Washington, D. C. (Procure through publications distribution channels.)
3. *Automobile Facts and Figures.* Automobile Manufacturers Association, New Center Bldg., Detroit 2, Mich. Annual publication.
4. *Automobile Stopping Distances for Different Road Conditions*—Chart. Educational Service, Dept. of Public Relations, General Motors Corp., Detroit 2, Mich. Free.
5. *Automotive Transportation Trends and Problems.* Owens, Wilfred. The Brookings Institution, Washington, D. C. 1949. 154 pp. $2.00.
6. *Driver Education, A Student's Manual and Workbook,* Center for Safety Education, Prentice-Hall, Inc., 1955, Englewood Cliffs, N. J. 164 pp.
7. *Here Are The Facts!* Basic winter driving rules on techniques, equipment, safe practices. Committee on Winter Driving Hazards, NSC, Chicago, Ill. 1952. 17 pp.
8. *Highway Safety and Driver Education.* Brody, Leon and Stack, Herbert J. Prentice-Hall, Inc., New York, N. Y. 1954. 464 pp.
9. *How to Drive.* American Automobile Association, 1712 G St., N. W., Washington 6, D. C. 122 pp. 75¢. (Headquarters USAF will initially provide, through major air command headquarters, limited quantities of this reference for use as a reading reference for students. Additional copies will be procured locally.)
10. *How to Drive Better and Avoid Accidents.* Kearney, Paul W. Thomas Y. Crowell Co., New York, N. Y. 1953. 238 pp.
11. Kit "A"—No. 3309. About 50 announcements, reprints, posters, and booklets from automobile manufacturers. AAA, Washington, D. C. 82¢ plus postage. (Weight—4 lbs.)
12. Kit "B"—No. 3329. About 30 items including written tests, road tests, and dual-control car forms. AAA, Washington, D. C. 75¢ plus postage. (Weight—15 oz.)
13. Kit "C"—No. 3310. About 30 items for advanced driver education, including research reports. AAA, Washington, D. C. 75¢ plus postage. (Weight—1 lb., 9 oz.)
14. Kit "D"—No. 3777. About 40 items on related subjects such as elementary school safety, highway engineering, motor vehicle inspection, pedestrian protection, and school safety patrols. AAA, Washington, D. C. $1.45 plus postage. (Weight—1 lb., 13 oz.)
15. *Let's Drive Right.* Halsey, Maxwell. Scott, Foresman & Co., New York, N. Y. 1954. 465 pp.
16. *Local Traffic Regulations.* Local Traffic & Police Depts.
17. *Man and the Motor Car.* The Center for Safety Education, New York University, Prentice-Hall Publishing Co., Englewood Cliffs, N. J. 1954. 367 pp.
18. *Manual on Uniform Traffic Control Devices for Streets and Highways.* U. S. Bureau of Public Roads. With revisions, 1954. Government Printing Office, Washington, D. C.
19. *Model Traffic Ordinance.* U. S. Bureau of Public Roads. 1953. Government Printing Office, Washington, D. C.
20. *Night Visibility.* Bulletin No. 89. Highway Research Board, Washington, D. C. 1954. 75 pp. $1.05.
21. *Project Workbook for Sportsmanlike Driving.* AAA, Washington, D. C. 164 pp. 57¢.
22. *Sportsmanlike Driving.* AAA, Washington, D. C. 460 pp. $2.10.
23. *State Motor Vehicle Codes.* Your own State Motor Vehicle Dept.
24. *Teachers Manual and Unit Tests for Man and the Motor Car,* Center for Safety Education, N. Y., Prentice-Hall, Inc., Englewood Cliffs, N. J. 1954. 112 pp.
25. *Teacher's Manual for Sportsmanlike Driving.* AAA, Washington, D. C. 191 pp. 53¢.
26. *The Uniform Vehicle Code.* National Committee on Uniform Laws & Ordinances. 1954. 1604 K St., N. W., Washington, D. C.
27. *Things the Professional Truck Driver Should Know.* American Trucking Associations, Inc., Washington, D. C. 1955. 75 pp. 40¢.
28. *USAF Ground Accident Digest,* USAF Periodical 32-4, Monthly, Hq USAF, Washington, D. C. (Procure through publications distribution channels.)
29. *You and Your Car Insurance.* Coughlin, George G., and Schneider, Joseph J. William Morrow & Co., New York. 1954. 122 pp. $2.95.

(Whereupon, at 3: 10 p. m., the subcommittee adjourned.)

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